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ORDOVICIAN-SILURIAN LIMESTONE RESOURCES OF NEW BRUNSWICK

T.C. Webb and
D.V. Venugopal

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Ordovician–Silurian Limestone Resources of New Brunswick

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TYPICAL ORDOVICIAN-SILURIAN LIMESTONE LITHOTYPES

Silty, nodular limestones of the
La Vielle Formation at Limestone Point,
Gloucester County, New Brunswick.

Interbedded, arenaceous limestone
and calcarenites of the Limestone Point
Formation at Limestone Point,
Gloucester County, New Brunswick.

Interbedded, argillaceous limestone and slate of the Middle Ordovician to Early Silurian Carys Mills Formation at Siegas, Madawaska County, New Brunswick.

TABLE OF CONTENTS

Page

ABSTRACT vii

RÉSUMÉ vii

CHAPTER 1. INTRODUCTION 1

- Purpose and Scope 1
- Distribution of Ordovician and Silurian Limestone in New Brunswick 2

CHAPTER 2. LIMESTONE OCCURRENCES IN NORTHERN NEW BRUNSWICK: BAIE DES CHALEURS REGION 5

Ordovician Occurrences 5
- Nash Creek (21 O/16) 5
- Upsalquitch Forks (21 O/10) 8
- Tetagouche River-Armstrong Brook (21 P/12) 8
- Lincour (21 P/12) 14

Silurian Occurrences 14
- Limestone Point-Elmtree-LaPlante (21 P/13) 17
  - Geology 17
  - Exploration and Development 20
  - Resource Evaluation 21
- Hendry Brook-Belledune Station-Hodgin (21 P/13) 22
  - Geology 24
  - Exploration and Development 24
  - Resource Evaluation 24
- Quinn Point-Culligan (21 P/13) 24
  - Geology 26
  - Exploration and Development 26
  - Resource Evaluation 27
- South Branch Millstream River-Lower Tetagouche Lake (21 O/9) 27
  - General Geology 29
  - Detailed Geology 29
  - Exploration and Development 29
  - Resource Evaluation 30
- Black Point-Dickie Cove (21 O/16) 30
  - Geology 31
  - Resource Evaluation 31

Table of Contents continued

Page
Pointe La Roche (21 O/16) 32
  Geology 32
  Resource Evaluation 32
South Charlo River (parts of 21 O/16, 15, and 10) 34

CHAPTER 3. LIMESTONE OCCURRENCES IN NORTHWESTERN NEW BRUNSWICK 35

Siegas (21 O/4) 35
  Geology 35
  Exploration and Development 36
    Limestone 36
    Hematite 37
  Resource Evaluation 38
Salmon River (21 O/4) 38
  Geology 38
  Exploration and Development 38
  Resource Evaluation 39

CHAPTER 4. LIMESTONE OCCURRENCES IN WEST-CENTRAL NEW BRUNSWICK 41

Dorrington Hill (21 G/14) 42
  Geology 42
  Exploration and Development 42
  Resource Evaluation 42
Waterville (Central Waterville) (21 J/3) 43
  Geology 43
  Exploration and Development 45
  Resource Evaluation 45
Ashland (21 J/6) 45
  Geology 45
  Exploration and Development 45
  Resource Evaluation 46
Carlisle (21 J/6) 47
  Geology 47
    Craig Farm 47
    Shaw Farm 47

Table of Contents continued

Page
Exploration and Development 49
Resource Evaluation 50
Peel (21 J/6) 50
Geology 50
Exploration and Development 50
Resource Evaluation 51
Windsor (21 J/6) 52
Geology 52
Exploration and Development 52
Resource Evaluation 54

CHAPTER 5. LIMESTONE OCCURRENCES IN SOUTHWESTERN NEW BRUNSWICK 55

Letang-Frye Island (21 G/2) 55
Geology 55
Exploration and Development 58
Resource Evaluation 59

CHAPTER 6. CRITERIA FOR ASSESSING THE DEVELOPMENT POTENTIAL OF ORDOVICIAN-SILURIAN LIMESTONE RESOURCES IN NEW BRUNSWICK . . 61

CHAPTER 7. CONCLUSIONS 67

Baie des Chaleurs (Northern New Brunswick) 67
Northwestern New Brunswick 68
West-Central New Brunswick 68
Southwestern New Brunswick 69

SELECTED BIBLIOGRAPHY 71

APPENDIX 1. Priority ratings of parameters pertaining to the development potential of selected Ordovician-Silurian limestone deposits in New Brunswick 79

Table of Contents continued

Page

TABLES

Table 2-1. Silurian stratigraphic nomenclature: Baies des Chaleurs area, northern New Brunswick 16

Table 6-1 Explanation of development parameters and priority rating scheme for selected Ordovician-Silurian limestone deposits in New Brunswick 62

ILLUSTRATIONS

Figure 1-1. General distribution of Ordovician and Silurian limestone-bearing rocks in New Brunswick and mapped areas. 3

Figure 2-1. Location of Ordovician-Silurian limestone occurrences in Restigouche and Gloucester counties, Baie des Chaleurs area, northern New Brunswick 6

Figure 2-2. General Geology and limestone resources of the Nash Creek-Black Point area, Gloucester County, New Brunswick 7

Figure 2-3. General geology of the Armstrong Brook-Tetagouche River area, Gloucester County, New Brunswick 9

Figure 2-4. General outline of the Armstrong Brook limestone/dolomite deposit, Gloucester County, New Brunswick 11

Figure 2-5. Range of chemical analyses of samples from the Armstrong Brook limestone/dolomite deposit, Gloucester County, New Brunswick 12

Figure 2-6. General geology and limestone resources of the Lincour-North Tetagouche area, Gloucester County, New Brunswick 13

Figure 2-7. Geology and limestone resources of the Elmtree-LaPlante area, Gloucester County, New Brunswick 19

Figure 2-8. General geology of the Belledune area, Gloucester County, New Brunswick 23

Figure 2-9. General geology of the Quinn Point-Culligan area, Restigouche County, New Brunswick 25

Figure 2-10. Geology and limestone resources of the South Branch Millstream River and Lower Tetagouche Lake area, Gloucester County, New Brunswick 28

Figure 2-11. Geology of the Pointe La Roche-Charlo area, Restigouche County, New Brunswick. 33

Figure 2-12. General geology and limestone resources of the Charlo River-Upsalquitch River area, Restigouche County, New Brunswick 34

Table of Contents continued

Page
Figure 3-1. Location of Ordovician-Silurian limestone occurrences in Madawaska and Victoria counties, northwestern New Brunswick 36
Figure 3-2. Geological map of the limestone deposit at Siegas, Madawaska County, New Brunswick 37
Figure 3-3. Geology of the Salmon River limestone occurrence, Victoria County, New Brunswick 39
Figure 4-1. Location of Ordovician-Silurian limestone occurrences in Carleton and York counties, west-central New Brunswick 41
Figure 4-2. Geology of the Dorrington Hill limestone deposit, York County, New Brunswick 43
Figure 4-3. Geology of the Central Waterville limestone deposit, York County, New Brunswick 44
Figure 4-4. Geology of the Ashland limestone deposit, Carleton County, New Brunswick 46
Figure 4-5. Geology of the Carlisle limestone deposit, Carleton County, New Brunswick 48
Figure 4-6. Geology of the Peel limestone deposit, Carleton County, New Brunswick 51
Figure 4-7. Geology of the Windsor limestone deposit, Carleton County, New Brunswick 53
Figure 5-1. Location of the Letang Peninsula-Frye Island limestone occurrence, Charlotte County, New Brunswick 56
Figure 5-2. Location of the Letang Peninsula-Frye Island limestone deposit, Charlotte County, New Brunswick 57
Figure 6-1. Summary of development priorities for various Ordovician-Silurian limestone deposits in New Brunswick 63
Figure 6-2. Cumulative deposit ratings for selected development parameters: New Brunswick Ordovician-Silurian limestone deposits 65

PLATES

Plate 89-252. Geology and limestone resources of the Letang Peninsula-Frye Island area, Charlotte County. NTS 21 G/2. Scale: 1:10 000 .... in pocket

Plate 89-253. Geology and limestone resources of the Dorrington Hill area, York County. NTS 21 G/14. Scale: 1:10 000 .... in pocket

Plate 89-254. Geology and limestone resources of the Central Waterville area, York County. NTS 21 J/3. Scale: 1:10 000 .... in pocket

Plate 89-255. Geology and limestone resources of the Peel area, Carleton County. NTS 21 J/5. Scale: 1:10 000 .... in pocket

Plate 89-256. Geology and limestone resources of the Ashland area, Carleton County. NTS 21 J/6. Scale: 1:10 000 .... in pocket

Plate 89-257. Geology and limestone resources of the Carlisle area, Carleton County. NTS 21 J/6. Scale: 1:10 000 .... in pocket

Plate 89-258. Geology and limestone resources of the Windsor area, Carleton County. NTS 21 J/6. Scale: 1:10 000 .... in pocket

Plate 89-259. Geology and limestone resources of the Salmon River area, Victoria County. NTS 21 O/4. Scale: 1:10 000 ...... in pocket

Plate 89-260. Geology and limestone resources of the Siegas area, Madawaska County. NTS 21 O/4. Scale: 1:10 000 .... in pocket

Plate 89-261. Geology and limestone resources of the Black Point-Nash Creek area, Restigouche County. NTS 21 O/16. Scale: 1:50 000 .... in pocket

Plate 89-262. Geology and limestone resources of the Quinn Point-Culligan area, Restigouche County. NTS 21 P/13. Scale: 1:10 000 .. in pocket

Plate 89-263. Geology and limestone resources of the Belledune area, Gloucester County. NTS 21 P/13. Scale: 1:10 000 .... in pocket

Plate 89-264. Geology and limestone resources of the Elmtree-LaPlante area, Gloucester County. NTS 21 P/13. Scale: 1:10 000 ... in pocket

Plate 89-265. Geology and limestone resources of the South Branch Millstream River and Lower Tetagouche Lake area, Gloucester County. NTS 21 P/12. Scales: 1:40 000 .... in pocket and approximately 1:1800

Plate 89-266. Distribution of Ordovician and Silurian strata, northwestern and northern New Brunswick and limestone resource map areas. Scale: 1:500 000 .... in pocket

ABSTRACT

Limestone is one of the most useful and versatile industrial minerals produced in New Brunswick. Almost a million tonnes is quarried annually for various agricultural, construction, and chemical applications. Physical and chemical specifications for limestone-based products are becoming more stringent and end-use applications are expanding, particularly into the realm of pollution control. Although limestone is abundant in the Province, the supply of high quality stone, particularly high calcium varieties, is surprisingly limited.

Significant deposits of limestone and dolomite in Ordovician and Silurian rocks occur in the northern and northwestern parts of the Province. Others are found in west-central and southwestern New Brunswick.

Ordovician and Silurian limestone and related calcareous rocks rarely attain a grade and extent where they could be developed on a commercial scale. Although high quality limestone is known to exist locally in rocks of reefal origin, their distribution is somewhat erratic. The most favourable regions to explore for such deposits is along a narrow belt of Silurian-Devonian strata extending southwest from Petit Rocher on the Baie des Chaleurs to the Becaguimec River area, near Woodstock and in an area underlain by Ordovician-Silurian strata south and east of Woodstock.

RÉSUMÉ

Le calcaire est un des minerais industriels les plus versatiles et les plus utiles produits au Nouveau-Brunswick. Tout près d'un million de tonnes sont produites annuellement pour les industries de l'agriculture, de la construction et des applications chimiques. Les spécifications physiques et chimiques deviennent toutefois de plus en plus complexes à mesure que les possibilités d'utilisation se multiplient, principalement dans le domaine de la lutte contre la pollution. Bien que le calcaire abonde partout au Nouveau-Brunswick, la quantité de pierre de haute qualité est relativement restreinte, surtout celle à haute teneur en calcium.

On retrouve d'importants dépôts de calcaire et de dolomite dans des formations de l'ordovicien et du silurien dans les régions du nord et de l'ouest de la province. On en retrouve également un certain nombre dans les régions du centre-ouest et du sud-ouest de la province.

Le calcaire ordovicien et silurien ainsi que la roche calcaire apparentée atteignent rarement une teneur et une importance suffisantes pour permettre une exploitation commerciale. Bien qu'on connaisse l'existence, à l'échelle locale, de pierre de qualité élevée provenant de formations d'origine corallienne, celle-ci est plutôt dispersée. Les endroits les plus favorables pour la prospection se situent le long de l'étroite bande de roche du silurio-dévonien qui s'étend au sud-ouest de Petit-Rocher dans la Baie des Chaleurs jusqu'aux environs de la rivière Becaguimec, près de Woodstock ainsi qu'au sud et à l'est de Woodstock, où l'on retrouve une formation de roche de l'ordovicio-silurien.

CHAPTER 1. INTRODUCTION

Most of New Brunswick's major resource-based industries are dependent to some degree on a reliable, nearby supply of limestone, dolomite and/or their products. Limestone (lime), traditionally used as a soil conditioner and as a source of aggregate, has become an essential mineral commodity with a formidable list of industrial applications. Indeed, it is one of the most useful and versatile of all the industrial minerals produced in this province.

The importance of limestone to the Province is well documented. In the past, several deposits have provided many local farmers with a nearby, inexpensive source of agricultural lime. Extensive deposits at Havelock, straddling the boundary between Kings and Westmorland counties, have supplied two of New Brunswick's largest limestone manufacturing operations. Almost a million tonnes of limestone is quarried annually in the province for various agricultural, construction and chemical applications.

Limestone is present in virtually every geologic system in New Brunswick, but only in Carboniferous, Silurian (Ordovician) and Precambrian strata does it attain sufficient thicknesses and grades to be considered of some economic significance.

Physical and chemical specifications for limestone-based products are becoming more stringent and end-use applications are expanding, particularly into the realm of pollution control. Although limestones are relatively plentiful throughout much of New Brunswick, the supply of particular grades, such as high-grade calcium limestone, is surprisingly limited. Therefore, effective prospecting for undiscovered deposits and prudent management decisions affecting known deposits are becoming increasingly important. Exploration programs for limestone, have been undertaken both by government and private industry. Not only have these initiatives lead to the discovery of new deposits, but they have also contributed significantly to the evaluation of known deposits.

Over the last 25 years, significant developments within the province's limestone industry have included the expansion of Havelock Lime Works Ltd. into the production of quick and hydrated lime, and the opening of quarries and the establishment of a processing facility near Elmtree in northern New Brunswick.

PURPOSE AND SCOPE

Since the 1965 publication of J.B. Hamilton's "Limestone in New Brunswick" there has been no concerted effort to update information on the province's limestone resources. Information is currently scattered in various Mineral Resources files and reports, and in numerous mineral property assessment reports.

The primary objective of this report is to present information on significant deposits of limestone and dolomite occurring in Ordovician and Silurian rocks throughout New Brunswick. It is intended to be a handy compilation rather than a definitive work on these resources.

Assessing some of the Province's more well known deposits should provide a starting point for those individuals or companies considering exploration and possible future development of limestone resources. Both published and unpublished information obtained from the Mineral Resources files over the last two decades have contributed to this report. Included are pertinent data on access, topographic and geologic settings (stratigraphy and structure), and a summary of related exploration or development undertaken on specific deposits. Although preliminary observations concerning grades, tonnages, and quarry opportunities are presented for most deposits (Appendix 1), it is important to realize that comments in this regard are based on broad generalizations and cannot be considered as completely reliable without more detailed evaluation.

Field investigations, completed during the summer of 1984, included extensive sampling and mapping of several major Ordovician and Silurian limestone belts and outcrop areas in Carleton, Gloucester, Madawaska, Restigouche, Victoria, and York counties. One small deposit situtated on the Bay of Fundy coast in Charlotte County was also examined.

Representative samples from most deposits have been catalogued and are stored in an easily accessible manner at the Fredericton Regional Office of Mineral Resouces. Existing sample analyses from past investigations were compiled. Sample information (i.e., location, description, available analysis, etc.) and relevant drillhole data for most areas have also been compiled.

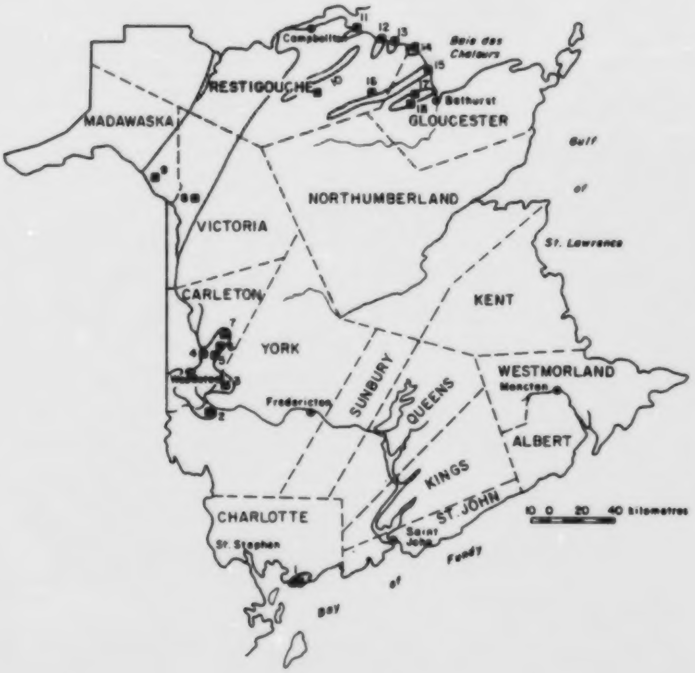
In the following chapters, detailed descriptions of Ordovician and Silurian limestone should acquaint the reader with many aspects of each deposit or occurrence. Some of the more significant deposits have been mapped at a scale of 1:10 000 (Fig. 1-1; plates listed in Table of Contents). Less detailed maps of the remaining deposits accompany the text.

DISTRIBUTION OF ORDOVICIAN AND SILURIAN LIMESTONES IN NEW BRUNSWICK

Ordovician and Silurian rocks are widely distributed throughout New Brunswick, underlying nearly 20% of the Province's land area. Although limestone and related calcareous rocks are well represented in both systems, rarely do they attain a grade and extent where they could be developed on a commercial scale.

Most of the more notable deposits occur in the northern and northwestern parts of the Province. Smaller deposits worthy of mention are found in west-central and southwestern New Brunswick near Woodstock and St. George, respectively (Fig. 1-1).

Ordovician-Silurian limestones can be broadly catagorized into four distinct groups, each separated areally from the others and each characterized by a particular lithologic assemblage. The first group occurs in the Baie des Chaleurs region where limestone-bearing units form an integral part of a thick sequence of Ordovician-Silurian clastics and volcanic rocks. The second group, located primarily in the northwest, is associated with Upper Ordovician-Silurian argillites and varieties of calcareous wackes and slates. A third group, situated in west-central New Brunswick near Woodstock, occurs within a sequence of grey and green calcareous sandstone, siltstone and slate. The last group, in southwestern New Brunswick on the Bay of Fundy coast, is associated with a sequence of rocks characterized by a preponderance of volcanics with only minor sedimentary varieties.



MADAWASKA
RESTIGOUCHE
Campbellton
Baie des Chaleurs
Bathurst
GLOUCESTER
Gulf of St. Lawrence
NORTHUMBERLAND
VICTORIA
CARLETON
KENT
YORK
SUNBURY
QUEENS
WESTMORLAND
Moncton
Fredericton
ALBERT
KINGS
ST. JOHN
Saint John
CHARLOTTE
St. Stephen
Bay of Fundy
10 0 20 40 kilometres
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18

■ Map areas (for Plates see Appendix 2; for Figures see text)

1. Letang Peninsula-Frye Island (Plate 89-252)
2. Dorrington Hill (Plate 89-253)
3. Central Waterville (Plate 89-254)
4. Peel (Plate 89-255)
5. Ashland (Plate 89-256)
6. Carlisle (Plate 89-257)
7. Windsor (Plate 89-258)
8. Salmon River (Plate 89-259)
9. Siegas (Plate 89-260)
10. Upsalquitch Forks-South Branch Charlo River (Figure 2-12, p. 34)
11. Pointe La Roche (Figure 2-11, p. 33)
12. Black Point-Nash Creek (Plate 89-261)
13. Quinn Point-Culligan (Plate 89-262)
14. Belledune (Plate 89-263)
15. Elmtree-LaPlante (Plate 89-264)
16. South Branch Millstream River-Lower Tetagouche Lake (Plate 89-265)
17. Lincour (Figure 2-6, p. 13)
18. Armstrong Brook-Tetagouche River (Figure 2-3, p. 9)

Figure 1-1. General distribution of Ordovician and Silurian limestone-bearing rocks in New Brunswick and mapped areas.

CHAPTER 2. LIMESTONE OCCURRENCES IN NORTHERN NEW BRUNSWICK: BAIE DES CHALEURS REGION

ORDOVICIAN OCCURRENCES

Notable Ordovician limestone deposits are not widespread in the Baie des Chaleurs region of northern New Brunswick. Occurrences have been documented at only five locations in Restigouche and Gloucester counties: 1) one at Nash Creek; 2) one in the Upsalquitch Forks area; and 3) three, 10 to 20 km west of Bathurst (Fig. 2-1). Some occurrences in the region are represented by interbedded argillaceous limestone and mudstone of the Matapedia Group while others are associated with an intensely deformed belt of Cambro-Ordovician volcanic and sedimentary rocks belonging to the Tetagouche Group.

NASH CREEK (21 O/16)

Limestone of the Matapedia Group is well exposed along the coast of the Baie des Chaleurs, approximately 3 km northwest of Nash Creek in Restigouche County. These rocks form part of a north-south-trending band over 0.5 km wide, traceable for almost 5 km (Fig. 2-2). The limestone unit is bound to the east by a north-south-trending fault and is overlain by Silurian strata to the west. Striking north-south, with dips varying from vertical to 50° to the west, the unit is estimated to exceed a true thickness of 250 m.

Access to the deposit varies over its length; however, most of the more prominent exposures either occur along the coast less than 250 m north of Highway 134 or can be reached via a network of secondary roads and power line right-of-ways to the south.

The area underlain by the Nash Creek limestone is characterized by a gentle, seaward sloping, lightly forested topography, seldom exceeding 90 m above sea level. Approximately 65% of the land area consists of open field and pasture. Overburden cover in the region is anticipated to vary up to 4 m thick.

Lithologically, the limestones in the area are dominated by dark grey, even-bedded calcisiltites and calcilutites, interbedded with arenaceous siltstone and mudstone. Individual limestone beds range up to 5 cm thick, whereas intervening siltstone/mudstone layers rarely exceed 2 cm. Locally, numerous calcite veins cut across bedding planes.

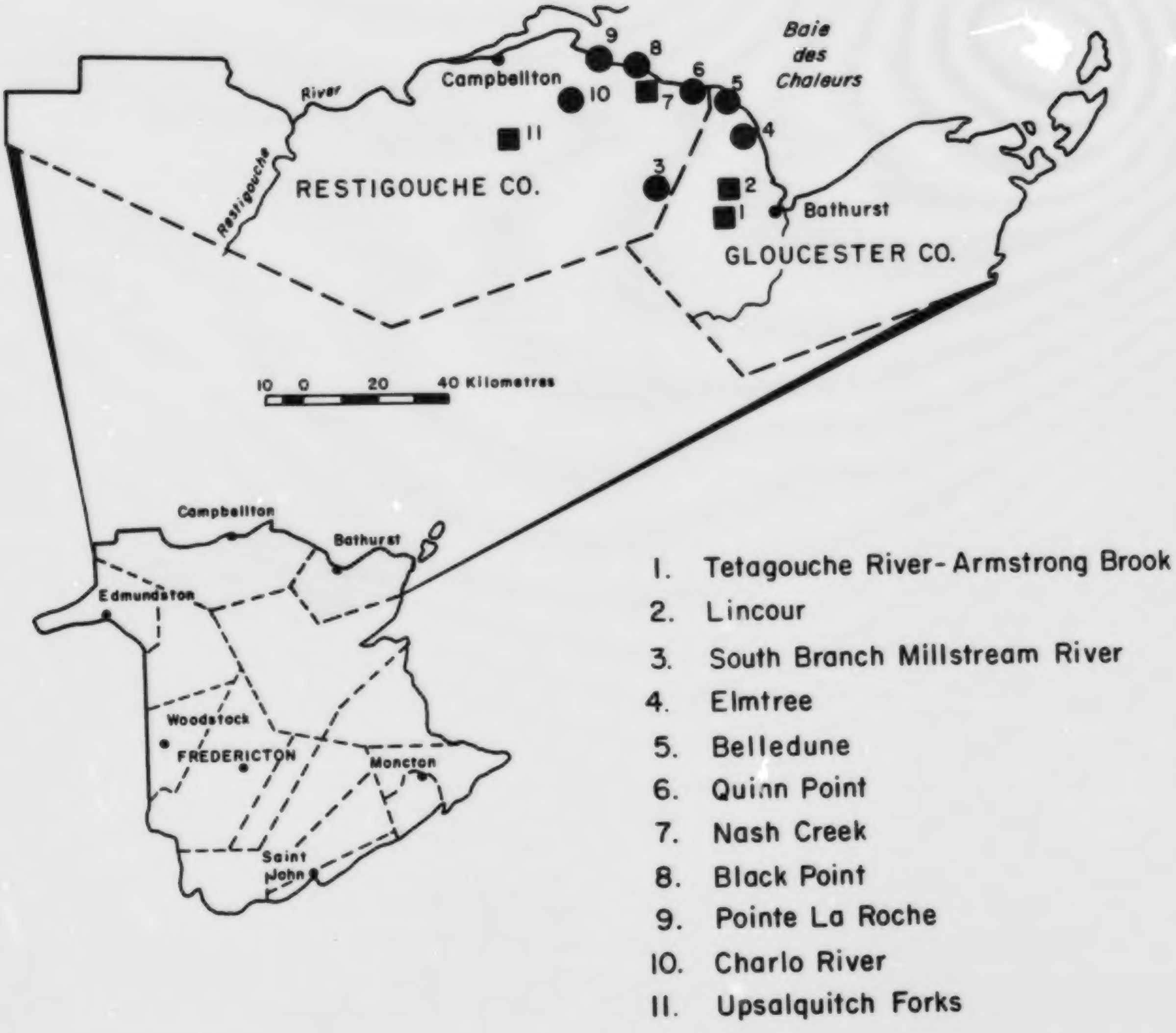

Baie des Chaleurs
Campbellton
River
Restigouche
RESTIGOUCHE CO.
GLOUCESTER CO.
Bathurst
10 0 20 40 Kilometres
Campbellton
Bathurst
Edmundston
Woodstock
FREDERICTON
Moncton
Saint John
1. Tetagouche River-Armstrong Brook
2. Lincour
3. South Branch Millstream River
4. Elmtree
5. Belledune
6. Quinn Point
7. Nash Creek
8. Black Point
9. Pointe La Roche
10. Charlo River
11. Upsalquitch Forks

Figure 2-1. Location of Ordovician-Silurian limestone occurrences in Restigouche and Gloucester counties, Baie des Chaleurs area, northern New Brunswick. (■ represent Ordovician locales; ● represent Silurian locales)

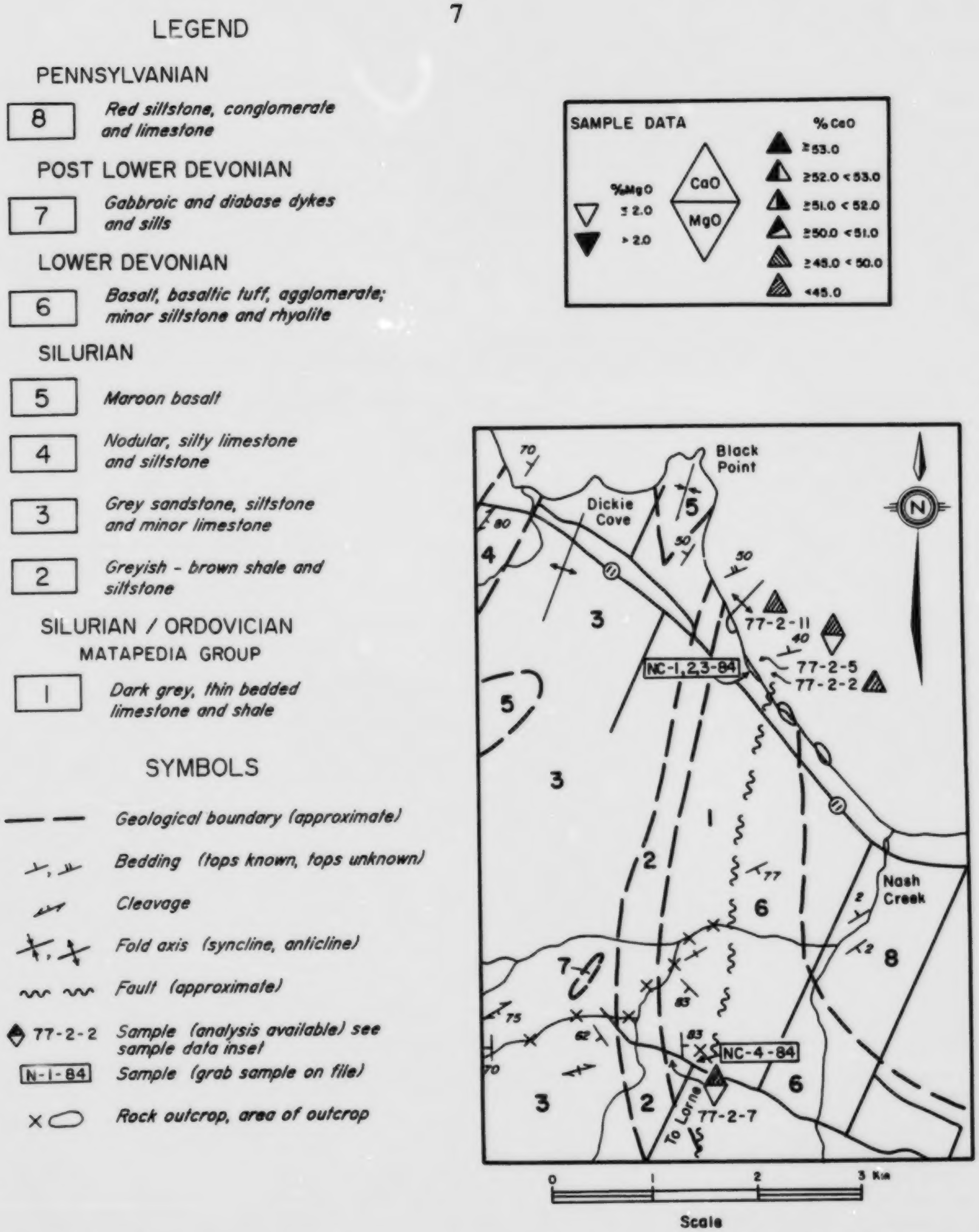

LEGEND
PENNSYLVANIAN
8 Red siltstone, conglomerate and limestone
POST LOWER DEVONIAN
7 Gabbroic and diabase dykes and sills
LOWER DEVONIAN
6 Basalt, basaltic tuff, agglomerate; minor siltstone and rhyolite
SILURIAN
5 Maroon basalt
4 Nodular, silty limestone and siltstone
3 Grey sandstone, siltstone and minor limestone
2 Greyish - brown shale and siltstone
SILURIAN / ORDOVICIAN
MATAPEDIA GROUP
1 Dark grey, thin bedded limestone and shale
SYMBOLS
Geological boundary (approximate)
Bedding (tops known, tops unknown)
Cleavage
Fold axis (syncline, anticline)
Fault (approximate)
77-2-2 Sample (analysis available) see sample data inset
N-1-84 Sample (grab sample on file)
Rock outcrop, area of outcrop
SAMPLE DATA
%MgO
≤ 2.0
> 2.0
CaO
MgO
% CaO
≥53.0
≥52.0 < 53.0
≥51.0 < 52.0
≥50.0 < 51.0
≥45.0 < 50.0
<45.0
Black Point
Dickie Cove
N
77-2-11
77-2-5
77-2-2
NC-1,2,3-84
NC-4-84
77-2-7
To Lorne
Nash Creek
70
80
50
50
40
77
2
2
83
83
75
62
70
Scale
0
1
2
3 Km

Figure 2-2. General geology and limestone resources of the Nash Creek-Black Point area, Gloucester County, northern New Brunswick (after Irrinki 1976; and Webb 1977).

Fossils are rare to absent in these rocks; however, some broken fragments of brachiopods, corals, and crinoid stems are found in some of the coarser grained limestone beds (calcarenites).

Lee and Noble (1977) have tentatively interpreted these limestones as a product of the allochthonous accumulation of fine-grained carbonate muds, slumping and sliding into a deep water, basinal depositional environment.

Reconnaissance mapping and limited sampling have revealed these deposits to be of relatively low quality. Chemical analysis of some of the visibly purer limestone beds have yielded CaO values generally less than 42%. Interbedded siltstone and mudstone comprise a significant proportion (up to 20%) of most exposures. It is anticipated this would further dilute the purity of limestone in any proposed quarry operation unless the deleterious material could be separated by some beneficiation process. The limestones are significantly harder and more resistant than the softer, associated siltstone and mudstones that possess a well developed cleavage. It is conceivable that a limestone-siltstone-mudstone separation could possibly be achieved by some form of an abrasion method, but the cost effectiveness of such a process would be questionable.

Although the Matapedia limestones in the Nash Creek area appear fairly extensive, the anticipated low quality of the resource would tend to disqualify it as a potential raw material for most limestone-related applications.

UPSALQUITCH FORKS (21 O/10)

Matapedia Group limestones, lithologically similar to those at Nash Creek, are well exposed adjacent to a north-south-trending logging road, approximately 10 km northeast of Upsalquitch Forks (Fig. 2-1). This occurrence is situated in a fairly rugged forested terrain, and is accessible via 80 km of logging roads and trails, southwest of Dalhousie. The remoteness of the deposit coupled with its probable low quality would tend to disqualify this particular site as a potential prime development target.

TETAGOUCHE RIVER - ARMSTRONG BROOK REGION (21 P/12)

Scattered outcrops of Ordovician limestone and dolomitic limestone are found associated with the Tetagouche Group rocks, situated 20 to 30 km west of Bathurst (Fig. 2-1). Most occurrences are confined to the Tetagouche River-Armstrong Brook region (Fig. 2-3) in Gloucester County.

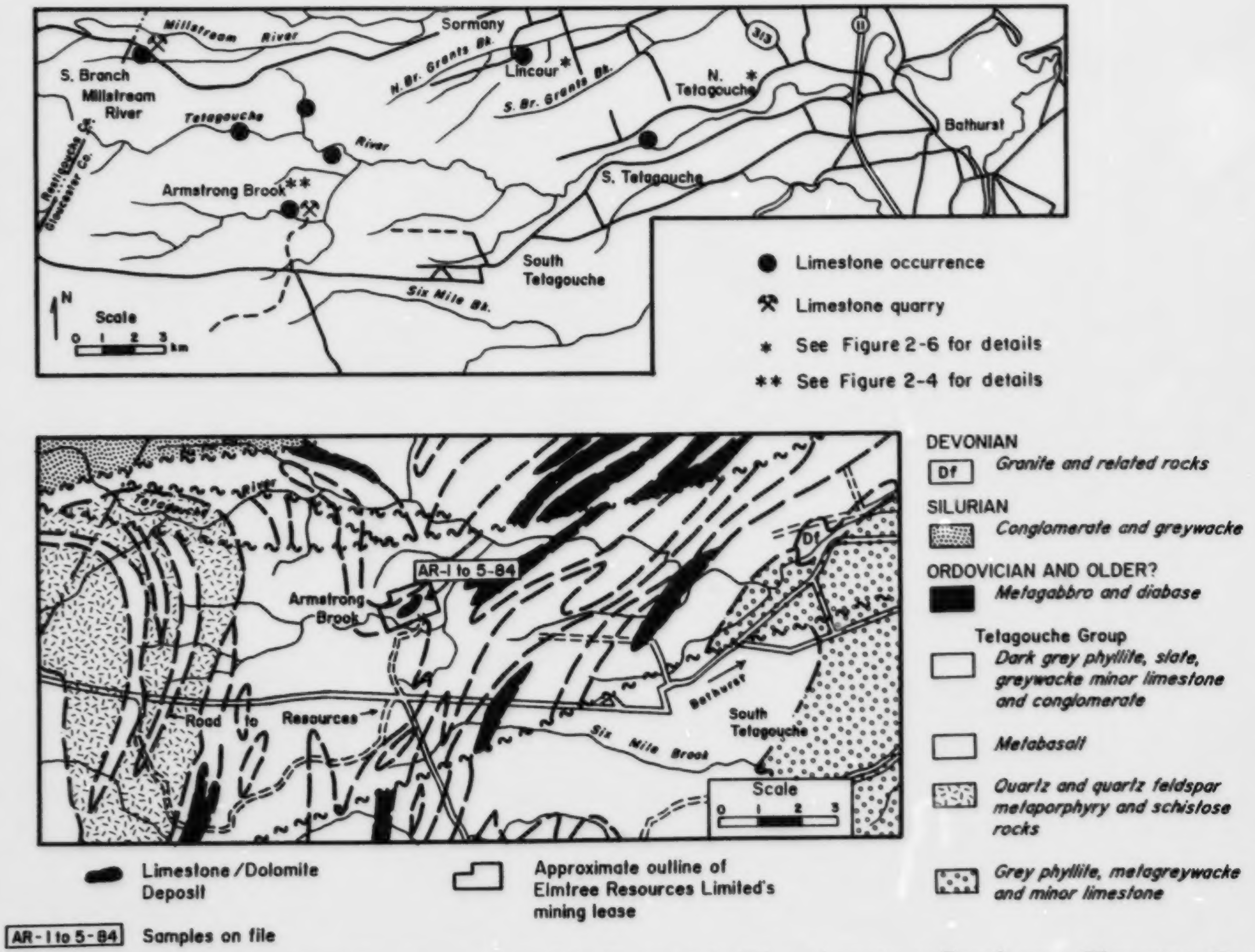

Millstream River
Sormany
S. Branch Millstream River
Tetagouche River
N. Br. Grants Bk.
S. Br. Grants Bk.
Lincour *
N. Tetagouche *
313
11
Bathurst
S. Tetagouche
Restigouche Co.
Gloucester Co.
Armstrong Brook **
South Tetagouche
Six Mile Bk.
N
Scale
0 1 2 3 km
● Limestone occurrence
⚒ Limestone quarry
* See Figure 2-6 for details
** See Figure 2-4 for details
Tetagouche River
AR-1 to 5-84
Armstrong Brook
Road to Resources
Bathurst
Df
South Tetagouche
Six Mile Brook
Scale
0 1 2 3
DEVONIAN
Df Granite and related rocks
SILURIAN
Conglomerate and greywacke
ORDOVICIAN AND OLDER?
Metagabbro and diabase
Tetagouche Group
Dark grey phyllite, slate, greywacke minor limestone and conglomerate
Metabasalt
Quartz and quartz feldspar metaporphyry and schistose rocks
Grey phyllite, metagreywacke and minor limestone
Limestone/Dolomite Deposit
Approximate outline of Elmtree Resources Limited's mining lease
AR-1 to 5-84 Samples on file

Figure 2-3. General geology and limestone resources of the Tetagouche River-Armstrong Brook area, Gloucester County, New Brunswick (after Davies 1977).

Medium to dark grey, highly contorted crystalline limestone, with frequent bands of siliceous material, outcrop at several locations along the banks of Tetagouche River, 2.5 km west of Big Narrows. About 300 m downstream of Big Narrows, similar limestone is found interbedded with grey phyllitic rocks. Another significant deposit in the area is exposed 800 m southwest of the confluence of Armstrong Brook and Tetagouche River. This deposit, referred to as the Armstrong Brook deposit, consists of argillaceous to siliceous phyllitic, tuffaceous and assorted metasedimentary rocks.

The existence of the dolomite, dolomitic limestone, and limestone associated with Armstrong Brook deposit has been known for many years. It may have been utilized many years ago by local farmers as a source of agricultural lime. The deposit, briefly investigated in the 1950's and the early 1970's, has been recorded on various regional geological maps (Skinner 1974; Fyffe 1975) over the years. In 1982, it was staked by Elmtree Resources Ltd., who subsequently established a 161 ha mining licence covering the property in 1983, following a comprehensive mapping and sampling program that outlined the approximate extent of the limestone-dolomite resource. The company has since proceeded to develop the deposit, which has required the construction of 3 km of new road over rugged forested terrain, south to the "Road to Resources." Dolomite has been extracted periodically from a small quarry on the site and transported to the company's processing facility at Elmtree, 25 km to the northeast.

The Armstrong Brook deposit appears well situated for quarrying, being located in a wilderness area, on a steep hillside guaranteeing excellent drainage. Overburden, in the immediate vicinity of the quarry, generally consists of a discontinuous veneer of till less than 0.5 m thick.

Dolomitic rocks are well exposed at four locations in the area of proposed quarry development (Fig. 2-4). The most prominent outcrops occur in the northern portion of the property where extensive sampling has returned average grades of 33.5% CaO and 17.4% MgO at "location A" and 31.2% CaO and 17.4% MgO at "location B." Outcrops at "locations C and D" returned CaO and MgO values of 28.6 to 30.3% and 20.2 to 22.0%, respectively. The chemistry of this deposit is summarized in Figure 2-5. Should the dolomite zone be found to be continuous between various outcrop locations, it is estimated that reserves in excess of 2 million tonnes may be available to a depth of 25 m.

A reconnaissance examination of the deposit has raised some questions regarding its composition, extent, and distribution along strike beyond the explored area. The dolomite is found closely associated with phyllitic and other metasedimentary rock types. The contact relationship between these rocks and the limestone/dolomite appears to be fairly discordant. Phyllites are highly folded and contorted, whereas the dolomitic strata do not appear to show evidence of severe deformation. It is not known whether the dolomite represents boundinaged remnants of a once more continuous bed(s), or represents large allochthonous blocks of a reefal or mid-slope lithology originally deposited in shallow water and later

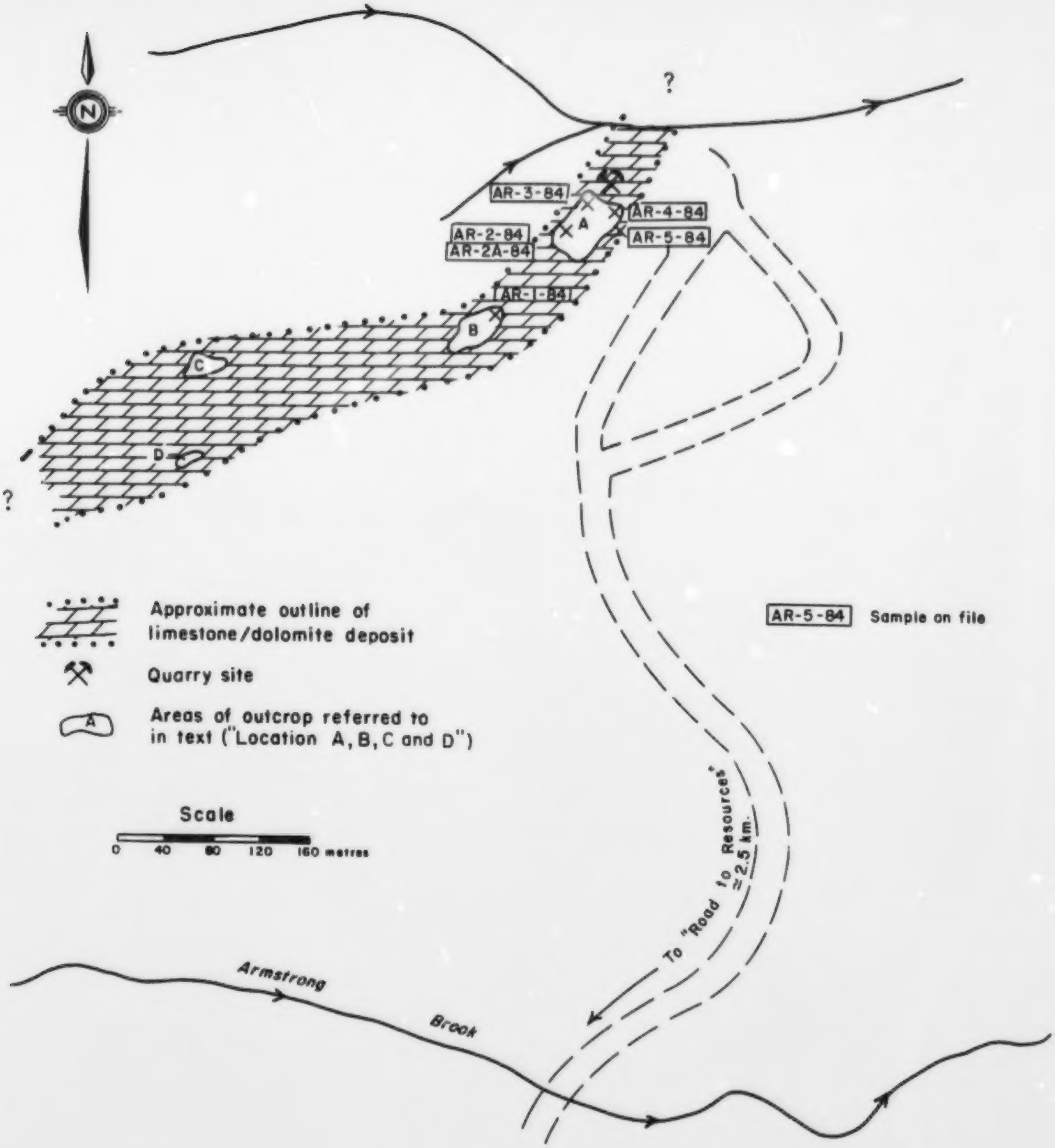

?
AR-3-84
AR-4-84
A
AR-2-84
AR-2A-84
AR-5-84
AR-1-84
B
C
D
?
Approximate outline of limestone/dolomite deposit
Quarry site
Areas of outcrop referred to in text ("Location A, B, C and D")
AR-5-84 Sample on file
Scale
0 40 80 120 160 metres
To "Road to Resources" ≃2.5 km.
Armstrong Brook

Figure 2-4. General outline of the Armstrong Brook limestone/dolomite deposit, Gloucester County, New Brunswick.

transported to deeper water environments by gravity sliding. More work is required to verify the origin of these deposits. Whatever the interpretation, the possibility remains that the distribution and significance of these deposit(s) may vary considerably along strike.

Another notable occurrence of limestone in the Tetagouche River-Armstrong Brook area is situated near North Tetagouche, adjacent to Tetagouche River, about 1.5 km below Tetagouche Falls. It is reached by following the North Tetagouche-Bathurst highway for about 3.5 km west of the community of North Tetagouche and proceeding 300 m south, via a trail, down a steep embankment (Fig. 2-6) to exposures on the river bank.

The geology of the area has been mapped and described by Fyffe and Williams (1975) and Skinner (1974). Arenaceous limestone is associated with a sequence of dark grey to greenish grey slate, phyllite, quartzite, and minor conglomerate, all belonging to the Tetagouche Group. The limestone is a dark to medium grey, crystalline calcarenite accompanied by siliceous banding. It is often interbedded with conglomerate. The main limestone-bearing zone strikes to the northeast and dips almost vertically. It is about 40 m wide and traceable for a distance of 225 m. Chemical analyses of several samples indicate that the limestone is probably too siliceous to be considered for future development. The CaO values of some of the visibly higher quality beds seldom exceed 40%.

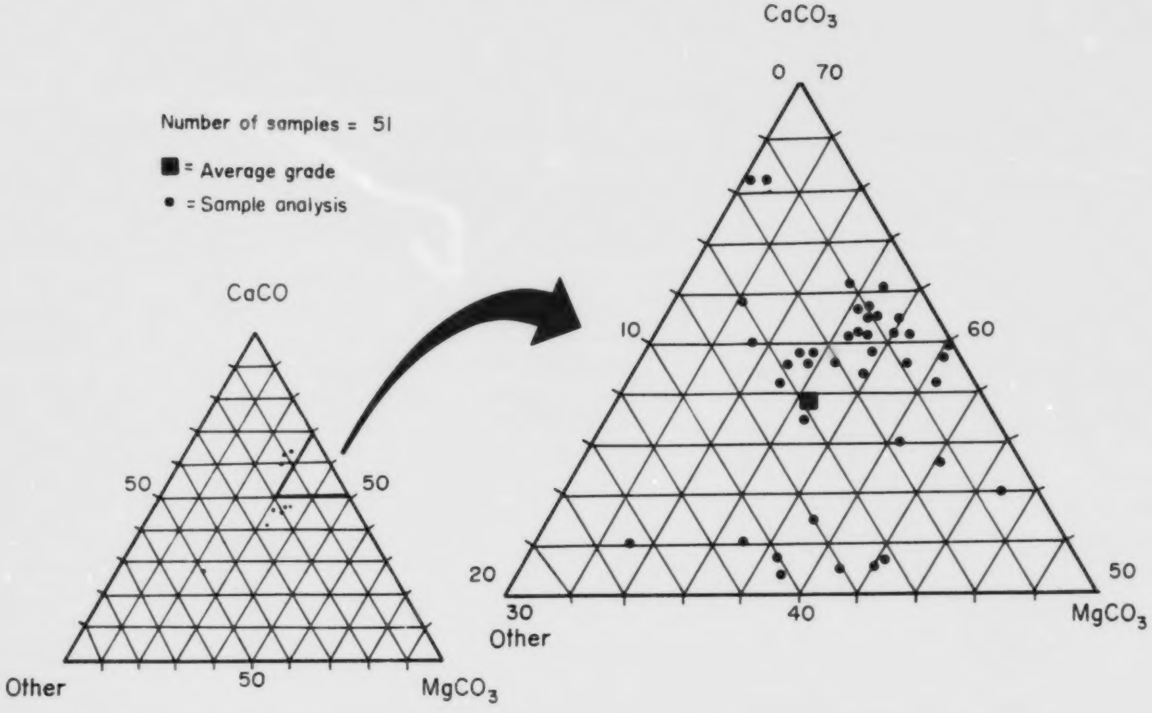


Figure 2-5. Range of chemical analyses of samples from the Armstrong Brook limestone/dolomite deposit, Gloucester County, New Brunswick.

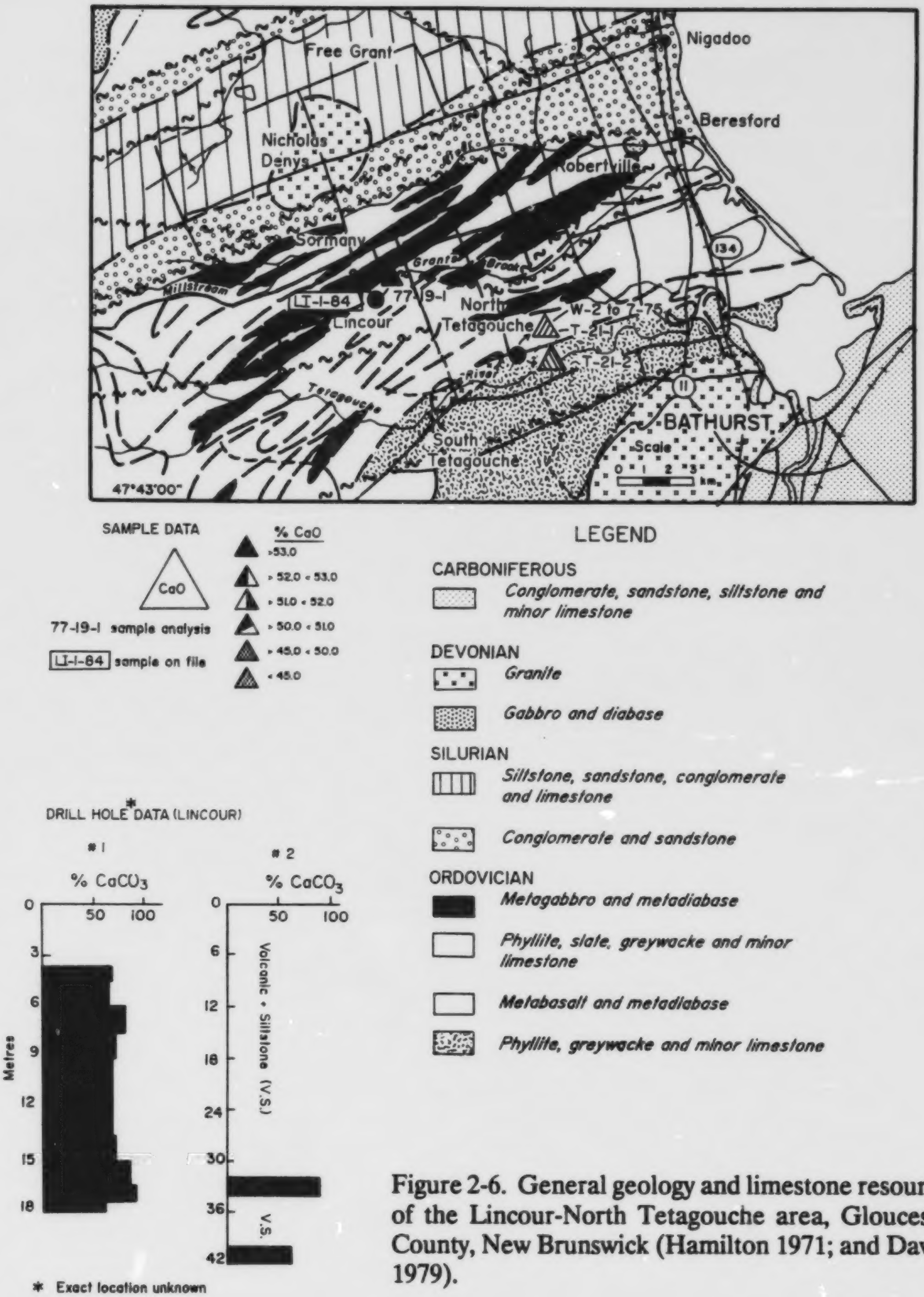

Nigadoo
Beresford
Free Grant
Nicholas Denys
Robertville
Sormany
Millstream
Grants Brook
134
LI-I-84
77-19-1
Lincour
North Tetagouche
W-2 to 7-75
T-21-1
T-21-2
Tetagouche River
11
BATHURST
South Tetagouche
Scale
0 1 2 3 km.
47°43'00"
SAMPLE DATA
CaO
77-19-1 sample analysis
LI-I-84 sample on file
% CaO
>53.0
> 52.0 < 53.0
> 51.0 < 52.0
> 50.0 < 51.0
> 45.0 < 50.0
< 45.0
LEGEND
CARBONIFEROUS
Conglomerate, sandstone, siltstone and minor limestone
DEVONIAN
Granite
Gabbro and diabase
SILURIAN
Siltstone, sandstone, conglomerate and limestone
Conglomerate and sandstone
ORDOVICIAN
Metagabbro and metadiabase
Phyllite, slate, greywacke and minor limestone
Metabasalt and metadiabase
Phyllite, greywacke and minor limestone
DRILL HOLE* DATA (LINCOUR)
# 1
% $CaCO_3$
0
50
100
3
6
9
12
15
18
Metres
# 2
% $CaCO_3$
0
50
100
6
12
18
24
30
36
42
Volcanic + Siltstone (V.S.)
V.S.
* Exact location unknown

Figure 2-6. General geology and limestone resources of the Lincour-North Tetagouche area, Gloucester County, New Brunswick (Hamilton 1971; and Davies 1979).

LINCOUR (21 P/12)

The Lincour limestone occurrence is located approximately 20 km northwest of Bathurst, in Gloucester County (Fig. 2-1). It is reached by a series of paved and gravel roads west of Highway 11 near Beresford. The occurrence consists of a few isolated outcrops found in a forested area adjacent to a large overgrown field, and less than 200 m northeast of a sharp westerly bend in the road at Lincour (Fig. 2-6).

Limestone is reported to have been quarried and burned at this location many years ago. As many as three kilns were reported to have operated here at one time, however, no definitive evidence exists of these operations, nor is there any evidence of extensive quarrying in the area.

Limestone at Lincour is interbedded with light grey phyllitic rocks which have been intruded by gabbro and diabase. Rocks in the area are highly deformed and altered. They strike northeasterly and exhibit moderate dips in the 40 to 50° range. Limestone is poorly exposed and its extent is largely inferred from a 4 to 6 m wide zone, of what some previous workers have called "sinkholes", traceable over a strike length of about 60 m (Hamilton, 1971).

The limestone is medium grey, fine-grained, and brecciated with granule to small pebble-sized breccia fragments set in a dark, fine-grained calcareous matrix. Thin shale films are present in bedding planes and in stylolytic partings. The Lincour deposit was discovered in the late 1960's by a local prospector, searching for base-metal mineralization. In 1970, the property was investigated by American Anaconda Brass Ltd. Three holes were reportedly drilled to determine the quantity and quality of the limestone. Drilling confirmed a band of low-grade limestone up to 12 m wide, extending over a strike length of 30 m with an average grade of about 40% CaO. Due to its apparent low quality and its relatively limited extent, the company failed to take up option on the property.

No evidence exists concerning the presence of additional limestone reserves elsewhere on the Lincour property. Overburden thicknesses in the area are estimated to range between 0.5 and 3.0 m.

SILURIAN OCCURRENCES

Most of the more extensive and better quality limestone deposits in northern New Brunswick are associated with Lower to Middle Silurian age strata. These rocks are found along, and proximal to, the shore of the Baie des Chaleurs between Campbellton and Beresford and in a few inland exposures in Restigouche and Gloucester counties (Fig. 2-1).

They have been described by Young (1911), Alcock (1935), Greiner (1970), Fyffe (1974), Noble (1976) Lee and Noble (1977), Webb (1983), Fyffe and Noble (1985), and Noble (1985).

Alcock noted striking similarities between the Silurian strata in northern New Brunswick and the Silurian, Chaleur Bay Series of the Gaspé region of Québec. Based on lithological similarities he extended the Chaleur Bay Series to include the strata in northern New Brunswick and subsequently subdivided the succession into two clastic units: 1) the Clemville and Gascons formations, separated by a marine carbonate unit; and 2) the La Vieille Formation (Table 2-1).

In 1970, Greiner expanded Alcock's broad terminology and divided the Silurian strata into four formations which he collectively referred to as the Chaleurs Group. Alcock's Chaleur Bay Series was renamed the Nash Creek Formation (Table 2-1).

During the mid 1970's, it became evident that the Nash Creek Formation could be further subdivided into a number of distinct units. The first attempt at this subdivision was undertaken by Fyffe (1974), who divided the formation into three informal mapping units (Table 2-1): a basal unit (Unit 5), consisting of grey-green and red-brown polymictic conglomerate and sandstone overlain by two successive units, comprising grey, nodular limestone with intercalations of volcanic rocks and boulder conglomerate (Unit 6), and a unit of red-brown sandstone with minor maroon porphyritic basalt (Unit 7).

In 1976, Noble took Fyffe's subdivision further, proposing the Nash Creek Formation be divided into four mappable units consisting of the lowermost Armstrong Brook Formation succeeded by the Limestone Point, La Vieille and Petit Rocher formations. With the exception of the Armstrong Brook Formation, all formations are limestone-bearing.

Armstrong Brook rocks, dominated by clastics, are considered to represent lowermost Silurian strata exposed in the Baie des Chaleurs area. The stratigraphic base of the formation is not seen and, therefore, its relationship with underlying rocks (probably of Ordovician age) is not exactly known. The upper contact, however, is fairly well defined and is placed at the rather abrupt transition from its generally coarse-grained, red-brown clastics to sandy limestones of the Limestone Point Formation.

The Limestone Point Formation consists of a sequence of grey-green, calcareous sandstone and limestone. Sandstone is usually medium-grained, occurring in well-bedded units, 5 to 15 cm thick with a few beds up to 60 cm thick. Limestone is found frequently interbedded with these rocks as irregular lenses of calcarenite. Fossils are abundant in this formation, with brachiopods, corals and crinoid ossicles being the most dominant.

Table 2-1. Silurian Stratigraphic Nomenclature:
Baie des Chaleurs Area, Northern New Brunswick (modified after Noble 1976)

AGE			Alcock (1935)	Greiner (1967, 70)	Fyffe (1974)	Noble (1976)
Ludlow				Benjamin Fm.	Unit 7	
				New Mills Fm.		New Mills Fm.
?				Bryant Point Fm.		Bryant Point Fm.
Wenlock			Gascon Fm.	Nash Creek Fm.	Unit 6	Petit Rocher Fm.
			La Vieille Fm.			La Vieille Fm.
Llandovery	Upper	C6			?	Limestone Pt. Fm.
		C5	Clemville Fm.		Unit 5	Armstrong Brook Fm.
		C4				
		C3				
		C2				
		C1				
	Middle					
	Lower					

main limestone bearing formations

The general character of Limestone Point rocks is best represented at the coastal type section at Limestone Point, just north of the village of Petit Rocher (Fig. 2-1). Other good exposures occur on the coast, south of Belledune, just west of Quinn Point and at Dickie Cove. Although facies equivalents occur in the South Charlo River area and at Upsalquitch Forks, these rocks are dominated by calcareous siltstones, shales, and sandstones. Only minor argillaceous limestone is present, and this would probably not be considered as a potential source of industrial grade material.

The upper stratigraphic boundary of the Limestone Point Formation is placed at the first occurrence of silty, nodular limestone of the La Vieille Formation. La Vieille limestone-bearing strata are highly fossiliferous and extend over a considerable area. Some of the more prominent exposures occur on the coast at Quinn Point, Culligan, Limestone Point, and Pointe La Roche (Fig. 2-1). Facies equivalents of La Vieille rocks are also found extending in a narrow southwest-trending band between the South Charlo and Northwest Upsalquitch rivers, a distance of more than 45 km (Fig. 2-1). Although grey, massive to laminated, calcareous siltstones dominate the lithology of this band, thick- to medium-bedded, highly fossiliferous nodular limestones and silty limestone occur locally (i.e., near Reid Brook).

A third assemblage of Silurian limestone-bearing rocks in the Baie des Chaleurs area are represented by strata associated with the Petit Rocher Formation. These rocks, comprising predominately red, green, and grey calcareous shales and siltstones with minor sandstone, contain remnants of Late Silurian carbonate reefs. These reefal structures and associated sediments seem to be restricted to a narrow zone(s) along the flanks of a regional syncline extending from Petit Rocher, 70 km southwest to the Upsalquitch Lake area (Fig. 2-1). Silty limestone and reefal limestone occur as sporadic outcrops and are exposed in small quarries thoughout the region. Among the best reefal exposures are those exposed along the "Road to Resources", north of Upsalquitch Lake; near the eastern outlet of Lower Tetagouche Lake, 14 km west of Sormany; and at LaPlante and Elmtree (Fig. 2-1). These limestones, probably representing large allochthonous blocks of reefal material, appear to rest on, and are embedded in, basinal calcareous clastics (turbidites). They are among the highest quality limestone deposits found in Silurian strata throughout the Province, and support northern New Brunswick's only limestone production facility at Elmtree.

LIMESTONE POINT-ELMTREE-LAPLANTE (21 P/13)

Notable occurrences of Silurian limestone are found north and west of the village of Petit Rocher, about 30 km north of Bathurst, in Gloucester County. Limestone is exposed at several places along the shore of the Baie des Chaleurs between Limestone Point and Petit Rocher, near, and in a quarry at, Elmtree and at LaPlante (Fig. 2-7). Most deposits are located within 500 m of major highways (Highway Nos. 11 and 134) or secondary roads in an area characterized by a light forest cover and large open fields. The westernmost limestone exposures, at LaPlante, lie within 3 km of the main line of Canadian National Railway. With the exception of coastal exposures, 80% of the area underlain by limestone varies between 15 and 30 m above sea level. The region is well drained by the Little Elmtree River and its tributaries.

Geology: Prominent Silurian limestone-bearing rocks of the Limestone Point, La Vieille, and Petit Rocher formations are well represented in the area.

At Limestone Point, both the sandy limestones of the Limestone Point Formation and the silty, nodular limestones of the La Vieille Formation are well exposed. Silurian stratigraphy at Limestone Point is represented by a thin, basal sequence of intercalated sandstone and limestone overlain by conglomerates of the Armstrong Brook Formation. Armstrong Brook rocks pass up into arenaceous sandstones and frequently interbedded limestones of the Limestone Point Formation. At this location, the formation is up to 250 m thick. Sandstone generally occurs as sinuous, even-bedded units, 5 to 15 cm thick. Limestone units occur as irregular lenses of predominantly calcarenite. These Limestone Point rocks form a band up to 200 m wide, striking generally to the southwest and dipping almost vertically. They are closely associated with two south-plunging anticlinal-synclinal structures (Williams 1976) (Fig. 2-7), and are traceable for almost 3 km inland from the coast to Madran. The formation is terminated to the south and west by east-west- and north-south-trending faults, respectively.

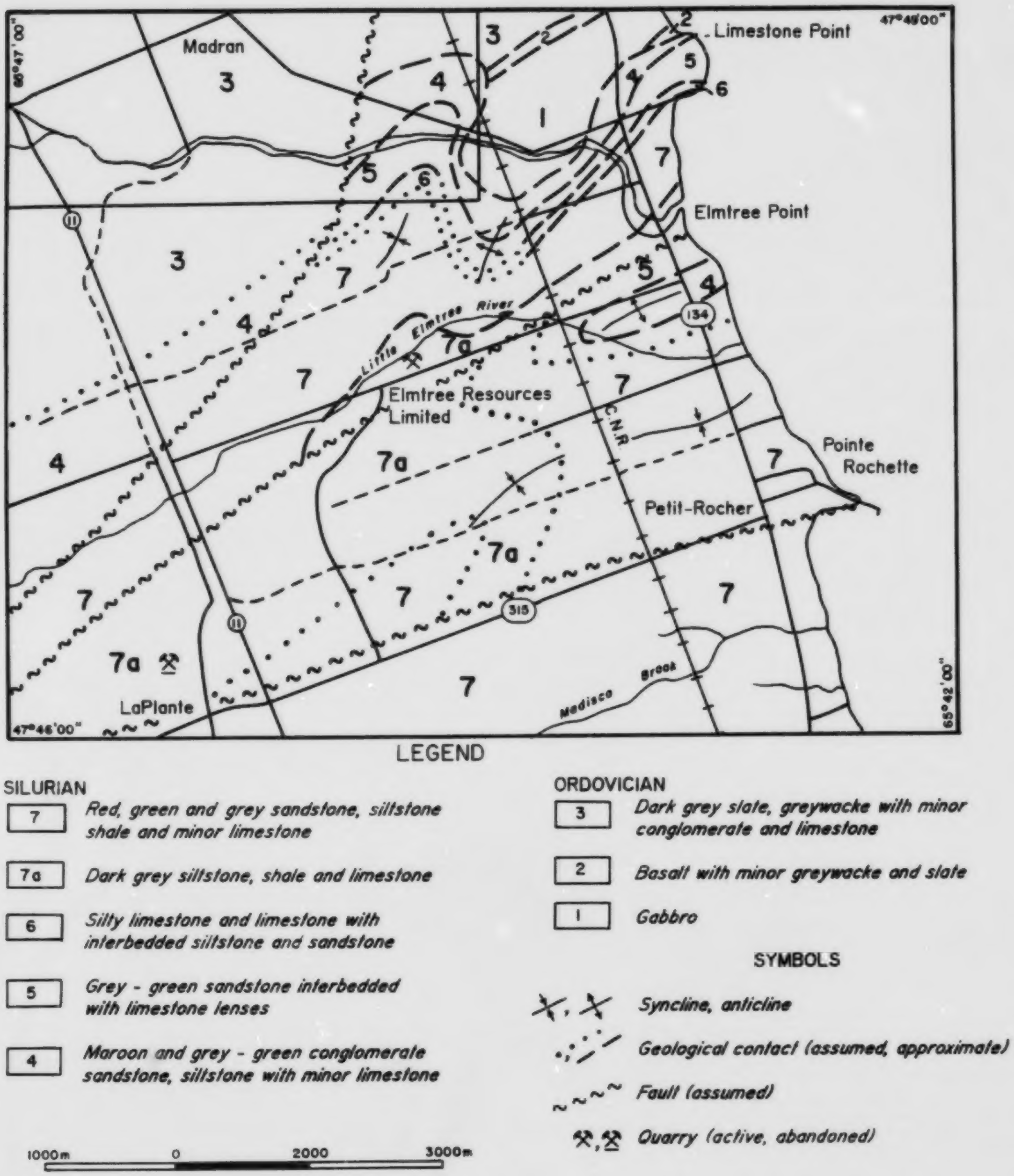

65°47'00"
47°49'00"
Madran
Limestone Point
Elmtree Point
Little Elmtree River
Elmtree Resources Limited
C.N.R.
Pointe Rochette
Petit-Rocher
LaPlante
Madisco Brook
11
134
315
47°46'00"
65°42'00"
1
2
3
4
5
6
7
7a
LEGEND
SILURIAN
7 Red, green and grey sandstone, siltstone shale and minor limestone
7a Dark grey siltstone, shale and limestone
6 Silty limestone and limestone with interbedded siltstone and sandstone
5 Grey - green sandstone interbedded with limestone lenses
4 Maroon and grey - green conglomerate sandstone, siltstone with minor limestone
ORDOVICIAN
3 Dark grey slate, greywacke with minor conglomerate and limestone
2 Basalt with minor greywacke and slate
1 Gabbro
SYMBOLS
Syncline, anticline
Geological contact (assumed, approximate)
Fault (assumed)
Quarry (active, abandoned)
1000m
0
2000
3000m

Figure 2-7. General geology and limestone resources of the Elmtree-LaPlante area, Gloucester County, New Brunswick. See Plate 89-264 for details.

Limestone Point strata grades up into rocks belonging to the La Vieille Formation,a sequence of massive, medium- to fine-grained, nodular limestone intercalated with calcareous siltstone and shale. The formation, about 30 m thick at Limestone Point, is highly fossiliferous with corals and brachiopods.

A minor unconformity separates the La Vieille rocks from the overlying predominant siliciclastics of the Petit Rocher Formation. Rocks of this formation are poorly exposed at Limestone Point, being best seen at low tide. In the Elmtree-LaPlante area, Petit Rocher rocks provide a host for prominent deposits of high calcium limestone, traceable from Elmtree Point, 5 km southwest to LaPlante. Although the formation is characterized by a thick sequence of mainly green-grey siltstone and sandstone of turbidite origin, coralline breccias and remnants of massive reefal structures are found near its stratigraphic top. Collectively, coralline rocks are referred to as the LaPlante unit (Noble 1985). They are found sporadically distributed along the axis of three southwesterly trending, double-plunging, fold structures (Fig. 2-7).

Exposures of LaPlante strata can best be seen at a quarry operation at Elmtree and in a few scattered outcrops extending to an old quarry site at LaPlante to the southwest. Contrasting lithologic associations at Elmtree indicate that the more massive reefal carbonates (high-calcium limestone) probably occur as large allochthonous blocks or sheets resting in a matrix of dark colored, fine-grained, limey, basinal siliciclastics. Preservation of original reefal structures is generally poor, a result of considerable shattering, recrystallization, pressure solution, and deformation resulting, in part, from movement along two southwest-trending fault systems, proximal to major outcrops in the area. Extensive recrystallization and deformation have obliterated evidence of internal bedding in reefal structures; however, it would appear that most strike to the northeast and dip steeply to the south.

Reefal rocks contain a diverse faunal assemblage dominated by stromatoporoids and encrusting algae. Other associated faunas consist of corals, gastropods, brachiopods, ostracods, bryozoa, and echinoderms. These rocks, pinkish in colour, are typically pure limestone with only minor deleterious components. Texturally, they can be classified as mainly boundstone found closely associated with biorudite and limey mudstone and siltstone.

Although the size of individual reefal blocks probably varies throughout the region, past experience has indicated that such structures are capable of supporting quarry operations with reserves in the order of several million tonnes. The current quarry operated by Elmtree Resources Ltd., representing one of several of these structures, covers an area of approximately 2.5 ha and has been quarried since the late 1970's to a depth of over 18 m.

Due to the somewhat erratic distribution of these high-calcium limestone masses, past exploration attempts have involved expensive and time consuming trenching techniques and "hit and miss" drilling over extensive areas. To overcome problems associated with locating and tracing the extent of these deposits, several simple, cost-effective geophysical techniques were investigated by the Department of Natural Resources and Energy personnel in 1981. Initial tests were carried out in areas of known outcrop as a check on the validity of the methods used. After experimentation with several methods, terrain conductivity and radiometrics were shown to have the greatest success delineating these high-calcium structures.

Terrain conductivity measured the difference in electrical resistance between the relatively pure terrigenous-free reefal limestone blocks and the more argillaceous clastics that enclose them. A sharp contrast was found to exist between the less conductive limestone and highly conductive siltstone and shales. Significant drops in the conductivity of the argillaceous rocks seemed to coincide with zones of increasing limestone content. Actual examination of rock types, over which conductivity profiles were run, indicate that conductivity is also probably a function of density, porosity, and clay mineral content of the rock being profiled. The purer reefal limestones are more massive, whereas the argillaceous clastics are highly cleaved and fractured. The formation water content is apparently higher in the clastics.

Gamma-ray radiometric measurements, in areas of known rock types, showed that limestone emitted less radioactive response than the clastics and overburden material. A drop in radioactive response over limestone masses was found to be very pronounced for both the total count and potassium channels of the equipment used.

Exploration and Development: The limestone deposits in the Elmtree-LaPlante area have been recorded on numerous regional geologic maps (Alcock 1935; Williams 1976; Fyffe and Noble 1985) since the early 1900's. These rocks have been the subject of considerable study during the synthesis of a regional stratigraphic nomenclature for Silurian strata in this part of northern New Brunswick.

Quarrying was apparently carried out in the area prior to 1880 near the present day site of the Elmtree Resources Limited quarry. The Elmtree quarry was reopened in the early 1930's and a small crushing facility was operated intermittently by Elmtree Limestone Cooperative Limited up until the early 1960's, supplying local demand for agricultural lime and road metal.

In 1963, East Coast Smelting and Chemical Company undertook a limited drilling program to further evaluate the limestone potential of the area. Although several holes were drilled, all failed to intersect a favourable limestone deposit.

Interest in the Elmtree property was renewed in 1974 when 16 mining claims were staked, mapped and sampled by Minuvar Ltd. In 1975, mining claims in the LaPlante area were added to those at Elmtree. Further mapping and sampling by Minuvar and the Department of Natural Resources and Energy led to the conclusion that the

Elmtree-LaPlante limestone was part of a continous band offset along strike by a number of north-south-trending faults. In the same year, the New Brunswick Department of Municipal Affairs undertook an engineering study pertaining to the establishment of a water reservoir in the vicinity of Petit Rocher. Part of the study involved drilling a number of holes to evaluate overburden and bedrock characteristics prior to consideration of constructing a dam across the Little Elmtree River. Eighteen holes, totalling 160 m, were drilled west of the Elmtree quarry. Good quality, highly fractured limestone was intersected in only two holes.

The Elmtree-LaPlante property was acquired by Elmtree Resources Ltd. in 1978. Subsequent to extensive trenching and mapping, the company established a 246 ha mining licence. The existing quarry was expanded and a crushing and screening plant and a large storage facility was constructed. Since production began, up to 60 000 tonnes of limestone is quarried and crushed annually. Most output is supplied to Brunswick Mining and Smelting Corporation Limited, as flux for their lead smelter at Belledune. Other products marketed include aggregate, fertilizer filler, and agricultural limestone.

Another small quarry, referred to as the Godin-Fournier Quarry, operated for a short time at LaPlante over 60 years ago. The quarry, long abandoned, is now overgrown. Although reliable information is scarce, the operation is believed to have provided local farmers with a source of agricultural lime.

Resource Evaluation: Due to their generally low and inconsistent quality, limestones at Limestone Point have never been considered as a potential source for high-calcium stone. Even though narrow zones of higher quality stone, with up to 54% CaO, occur locally in Limestone Point Formation rocks, thickness seldom exceeds 1 m, and lateral extent may be limited to only a few tens of metres.

At Limestone Point, nodular limestones of the La Vieille Formation, offer almost no development potential. Most of the deposit underlies a populated area and is less than 200 m from the coast. Grades seldom exceed 50% CaO.

Past attempts at reserve estimation have indicated that several million tonnes of high quality limestone may occur in an area underlain by the Petit Rocher Formation between the Elmtree Quarry and LaPlante. However, its scattered distribution and the potential variability in quality, laterally as well as vertically, would make any attempt at accurate reserve projections highly speculative. Chemical analyses of some of the higher quality deposits, near the Little Elmtree River just west of Elmtree Resource's processing plant, have yielded CaO contents ranging from 51 to 53%. However, trenching in the area has shown that the CaO content can be quite variable over a width of several metres.

In the LaPlante area, limestone grading less than 50% CaO, appears restricted to a few narrow zones. Each is probably not more than 15 m wide, with limited lateral extent, and separated from each other by calcareous shale and siltstone. Although the topographic setting, overburden thickness, and drainage would be considered favourable for potential quarry development, the proximity and high visibility of such an operation with respect to nearby dwellings, coupled with the apparent lack of extensive high quality reserves, would tend to disqualify the LaPlante area as having significant development potential.

HENDRY BROOK-BELLEDUNE STATION-HODGIN (21 P/13)

A belt of Silurian limestone, up to 1.5 km wide, extends about 2 km south of the coast at Belledune to Belledune Station, and then 5 km northwest to Hodgin in the northwestern part of Gloucester County (Fig. 2-1). Although scattered outcrops confirm its presence throughout the area, the best limestone exposures can be found on the coast near the mouth of Hendry Brook; 1.5 km west of Belledune Station; and along a 2 km railway spurline linking Brunswick Mining and Smelting Corporation Limited's smelter and adjacent fertilizer plant to the main C.N.R. rail line at Turgeon Station (Fig. 2-8).

The deposit is reasonably accessible, occurring within a kilometre of a major highway. It underlies an area characterized by light forest cover with scattered, open fields, and pasture land. Relief is relatively constant, ranging from 15 to 35 m above sea level. Drainage in the area is good, with Hendry Brook and its associated tributaries comprising the most significant stream network.

Except for heavy industrial development near the coast, land-use conflicts in the area underlain by limestone would appear minimal. However, almost 90% of the deposit occurs within an area reserved from prospecting and staking. This area was established in 1965 to serve as a buffer zone to accommodate any possible future expansion and other land requirements for Brunswick's smelter facility. This rectangular area covers approximately 1365 ha and extends along the coast of the Baie des Chaleurs from Belledune River to Belledune, and south to the C.N.R. rail line between Belledune Station and Hodgin.

Geology: Silurian limestone-bearing strata in this part of northern New Brunswick is typical of the mixed terrigenous and carbonate sediments associated with the Limestone Point Formation. As depicted in Figure 2-8, these rocks maintain a northwest-southeast strike, and dip to the north at angles seldom exceeding 60°. The formation is overlain to the north and east by a thick sequence of maroon siltstone, sandstone, and minor conglomerate belonging to the Petit Rocher Formation. To the south, Limestone Point rocks rest on greenish-grey and red-brown conglomerate, sandstone, and minor siltstone of the Armstrong Brook Formation. The westward extension of the limestone belt is terminated by a northeast-trending fault.

Lithologically, Limestone Point Formation rocks throughout the area consist of up

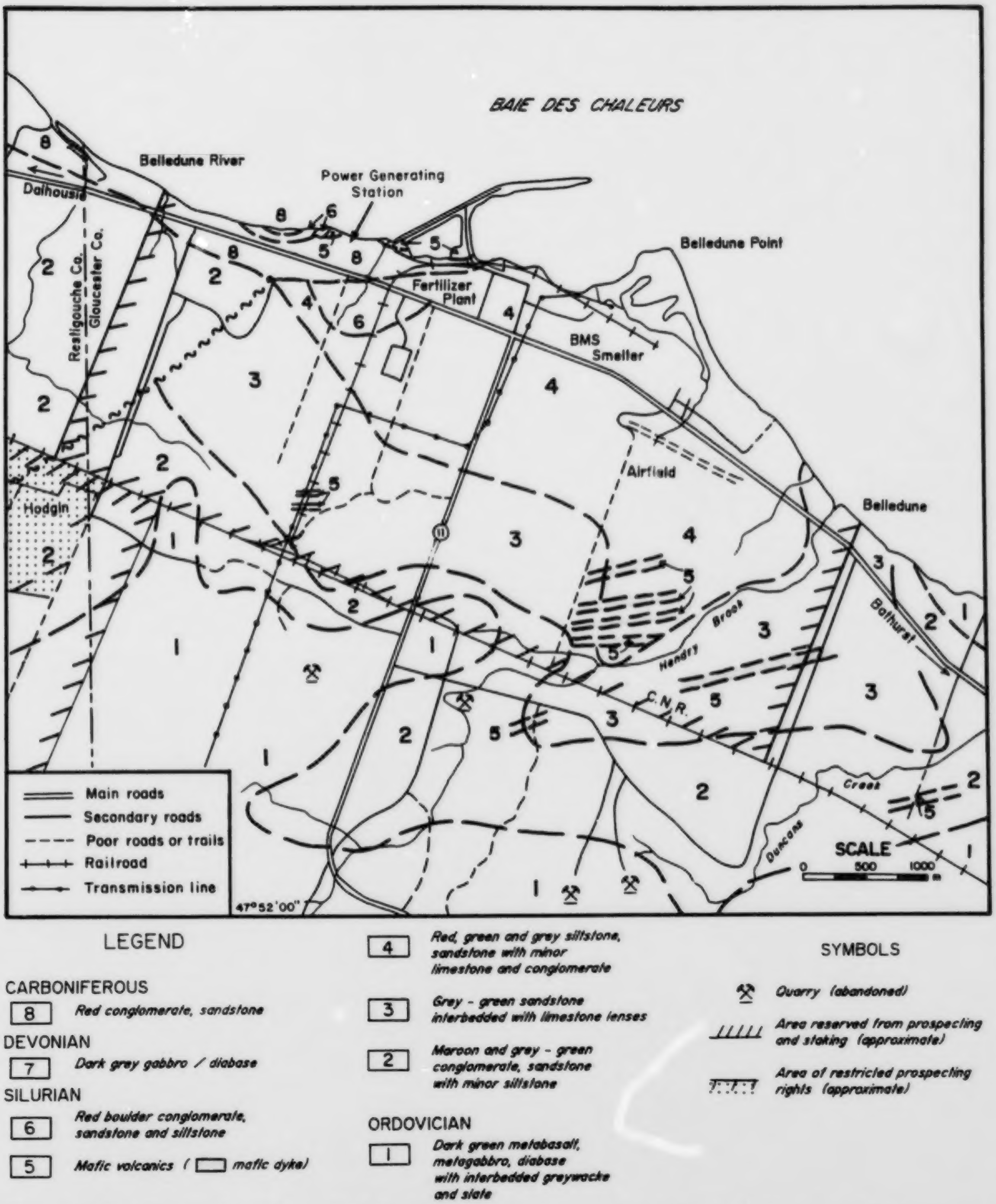

BAIE DES CHALEURS
Belledune River
Power Generating Station
Dalhousie
Restigouche Co.
Gloucester Co.
Fertilizer Plant
Belledune Point
BMS Smelter
Airfield
Hodgin
Belledune
Bathurst
Hendry Brook
C.N.R.
Duncans Creek
SCALE
0 500 1000 m
47°52'00"
Main roads
Secondary roads
Poor roads or trails
Railroad
Transmission line
LEGEND
CARBONIFEROUS
8 Red conglomerate, sandstone
DEVONIAN
7 Dark grey gabbro / diabase
SILURIAN
6 Red boulder conglomerate, sandstone and siltstone
5 Mafic volcanics (▭ mafic dyke)
4 Red, green and grey siltstone, sandstone with minor limestone and conglomerate
3 Grey - green sandstone interbedded with limestone lenses
2 Maroon and grey - green conglomerate, sandstone with minor siltstone
ORDOVICIAN
1 Dark green metabasalt, metagabbro, diabase with interbedded greywacke and slate
SYMBOLS
⚒ Quarry (abandoned)
Area reserved from prospecting and staking (approximate)
Area of restricted prospecting rights (approximate)

Figure 2-8. General geology and limestone resources of the Belledune area, Gloucester County, New Brunswick (modified after Fyffe 1974; Webb 1977; and Noble and Fyffe 1985). See Plate 89-263 for details.

limestone, often irregularly interbedded with varying amounts of calcareous siltstone and sandstone. The rocks are locally fossiliferous with numerous species of corals, pentamerids, brachiopods, and crinoids.

Exploration and Development: The extent of the Hendry Brook-Belledune Station -Hodgin limestone deposit is well documented on numerous regional geologic maps, going as far back as the early 1900's (Young 1911; Alcock 1935). Several of the more prominent limestone exposures have been sampled and analyzed by the Department of Natural Resources and Energy. Except for some limited drilling and bulk sampling carried out in the late 1970's near Belledune Station south of the reserved area, not much interest has been shown in the property.

Resource Evaluation: The fact that much of the area has been removed from prospecting and staking is an obvious deterrent to exploration and subsequent development. Despite this obstacle, there may be some potential for a large tonnage deposit outside the reserved area. However, the overall quality of the resource can be expected to be relatively poor and lack consistency. Chemical analyses of several representative samples from various outcrops throughout the region have yielded variable CaO values ranging from 18 to 53%. Given the near-shore, shallow water depositional environment interpreted for the Limestone Point Formation, limestone consistently exceeding 50% CaO would appear to be an exception rather than the rule.

QUINN POINT-CULLIGAN (21 P/13)

A small remnant of Silurian limestone occurs in the Quinn Point-Culligan area, located in the northeastern part of Restigouche County near the coast of the Baie des Chaleurs, 40 km northwest of Bathurst (Fig. 2-1). The surface trace of the limestone band is analogous to the shape of a "horse shoe", as it occupies a prominent assymetrical synclinal structure extending about 1 km southwest from the coast (Fig. 2-9). The Bathurst-Campbellton Highway (Hwy. 11) and the C.N.R. rail line cross the northern part of the deposit. The southern part is accessed by bush trails and an east-west-trending pipeline access corridor. The most prominent limestone outcrops are found on the shore at Quinn Point and Culligan, and inland along the C.N.R. rail line and a south-trending bush trail.

The area is characterized by a mixture of light forest cover in association with open fields north of the rail line. To the south, a denser forest cover predominates. The gradual increase in elevation from the coast up to 60 m near its southern limit results in adequate drainage for most parts of the deposit. Overburden thicknesses throughout much of the area seldom exceed 3 m.

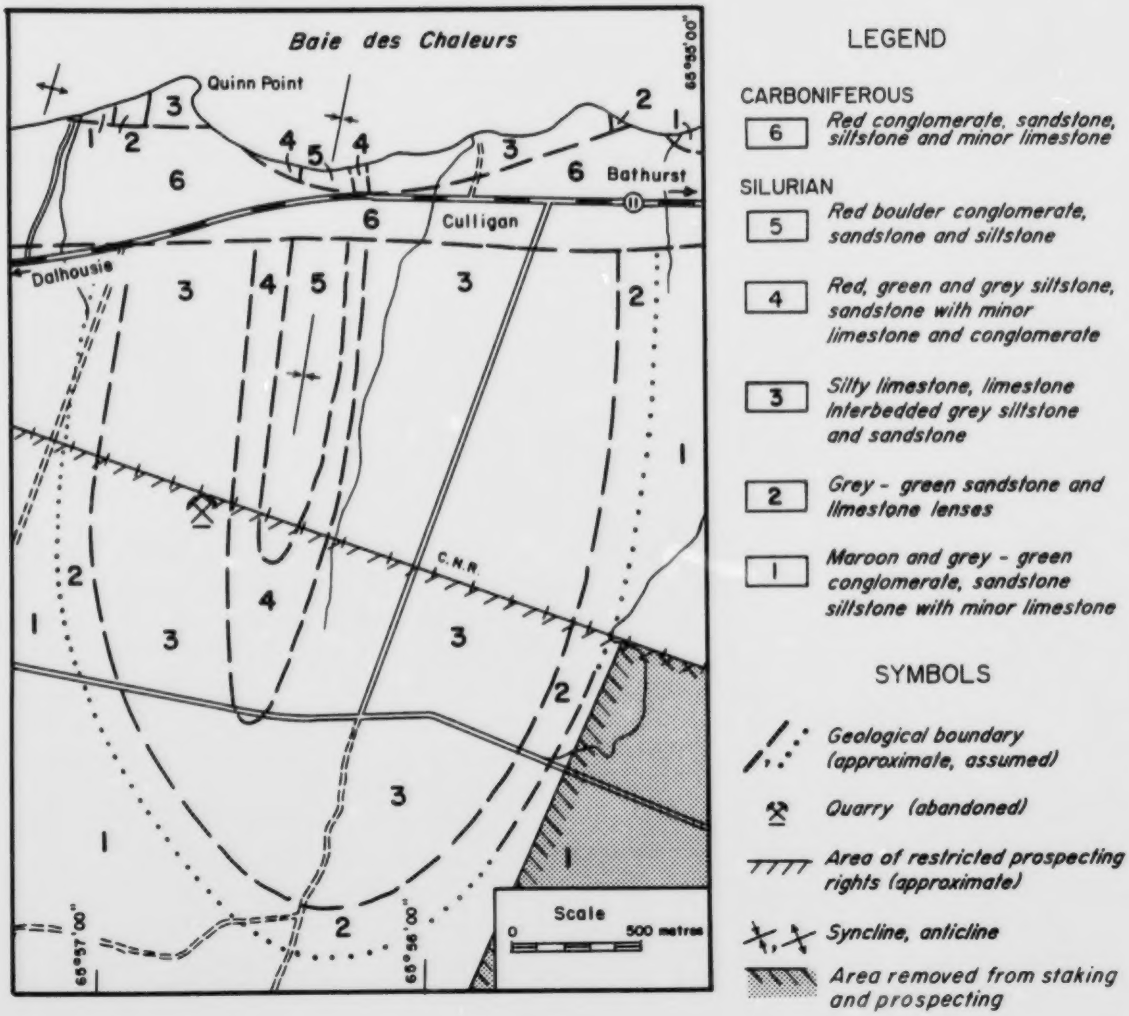

Baie des Chaleurs
Quinn Point
Bathurst
11
Culligan
Dalhousie
C.N.R.
1
2
3
4
5
6
65°55'00"
65°57'00"
65°56'00"
Scale
0
500 metres
LEGEND
CARBONIFEROUS
6 Red conglomerate, sandstone, siltstone and minor limestone
SILURIAN
5 Red boulder conglomerate, sandstone and siltstone
4 Red, green and grey siltstone, sandstone with minor limestone and conglomerate
3 Silty limestone, limestone interbedded grey siltstone and sandstone
2 Grey - green sandstone and limestone lenses
1 Maroon and grey - green conglomerate, sandstone siltstone with minor limestone
SYMBOLS
Geological boundary (approximate, assumed)
Quarry (abandoned)
Area of restricted prospecting rights (approximate)
Syncline, anticline
Area removed from staking and prospecting

Figure 2-9. General geology of the Quinn Point-Culligan area, Restigouche County, New Brunswick (modified after Fyffe 1974; and Noble and Fyffe 1985). See Plate 89-262 for details.

Although it would first appear that potential land-use conflicts are minimal, about 75% of the limestone deposit occurs within an area of restricted prospecting rights (Fig. 2-9). This area, covering approximately 2680 ha, was established in 1965 to serve as a buffer zone adjacent to a buried water pipeline extending from Jacquet River to the Brunswick Mining and Smelting Corporation Limited smelter at Belledune.

Geology: The Quinn Point-Culligan limestones belong to the La Vieille and Limestone Point formations with the former being most prominent. These rocks occupy a northeast-trending, assymetrical syncline that plunges in a northerly direction towards the Baie des Chaleurs at about 15°. The core of the syncline is occupied by rocks of the New Mills Formation, a succession of boulder conglomerate and associated red sandstone, underlain by red and green, siltstones and sandstone of the Petit Rocher Formation. La Vieille Formation limestones occur directly and conformably below this predominately terrigenous succession. Although scattered outcrops of the La Vieille Formation occur throughout the area, the most prominent exposures are found along the shore at Quinn Point and near Culligan. The formation, estimated at up to 300 m thick, consists of brownish to reddish grey to medium light grey, fine-grained, flaggy to massive to nodular limestone. Thin films to thin interbeds of calcareous shale and siltstone are often found dispersed throughout. The formation contains fossil remnants of a diverse faunal community consisting of corals, gastropods, bryozoa, stromatoporoids, brachiopods, and algae. Most evidence points to a deep-water, outer shelf depositional environment characterized by relatively low rates of sedimentation (Fyffe and Noble 1985).

Stratigraphically below the resistant silty limestones of the La Vieille, thin-bedded limestones and sandstones of the Limestone Point Formation form a sequence up to 140 m thick. Best exposed just west of Quinn Point, these rocks consist of sandy limestones interbedded with grey-green calcareous sandstone, frequently as irregular lenses. Similar to the overlying La Vieille, Limestone Point rocks are very fossiliferous with brachiopods, corals, and crinoid ossicles, all indicative of a predominately near-shore, shallow-water environment of deposition.

Major limestone-bearing formations of the Quinn Point-Culligan area overlie a thick sequence of red sandstones and grits referred to as the Armstrong Brook Formation. These rocks are traceable for a few kilometres westward along the coast from Quinn Point to Armstrong Brook where they are in fault contact with Devonian volcanics and related clastics.

Exploration and Development: The Quinn Point-Culligan limestones have been the target of numerous investigations over the last 30 years. Regional mapping and related academic studies pertaining to lower Paleozoic stratigraphy and paleogeography in this part of northern New Brunswick have made numerous references to Silurian limestone-bearing rocks of the area (Alcock 1935; Griener 1960; Greiner and Potter 1966; Fyffe 1974; Noble and Howells 1974; Noble 1976, 1979; Fyffe and Noble 1985). Even though the limestone was quarried on a limited scale many years ago, very little information pertaining to qualitative and quantitive assessment of the resource is available, except that which has appeared in a few reports by the Department of Natural Resources and Energy (Hamilton 1965; Webb and Kingston 1976)

Resource Evaluation: The southern half and extreme northern part of the Quinn Point-Culligan limestone deposit is situated within an area noted for its development restrictions. South of the C.N.R. rail line is an area of restricted prospecting rights, and to the north, potential development is restricted by habitation in the vicinity of the coastal Highway No. 11. These limitations tend to restrict the deposit's development potential to a small block of ground situated between the highway along the coast and the rail line. Although limestone is not well exposed here, samples collected and analyzed from a few outcrops along the coast to the north and the railway line to the south provide fairly reliable indicators as to the general quality of stone that can be expected. Of the fifteen grab samples analyzed from several prominent exposures, only one exceeded 53% CaO with ten failing to achieve 40% CaO. Even though these results would indicate limestone of rather poor quality for most applications, the possibility exists that higher grade zones may occur locally. Their occurrence and extent would require verification through extensive drilling or trenching accompanied by a comprehensive sampling program.

SOUTH BRANCH MILLSTREAM RIVER-LOWER TETAGOUCHE LAKE (21 0/9)

Two notable limestone occurrences, considered to be of Silurian age, are located about 34 km due west of Bathurst, straddling the boundary between Restigouche and Gloucester counties (Fig. 2-1). One occurrence is situated at the eastern outlet of Lower Tetagouche Lake, while the other is found to the northeast of the South Branch of the Millstream River (Fig. 2-10). At present, the Millstream River deposit is actively being quarried by Elmtree Resources Ltd.

Access to the area is via a logging road (Sormany Road) extending 14 km west of the settlement of Sormany. This road crosses the eastern end of the Millstream River deposit. The limestone at Lower Tetagouche Lake is best reached via a bush road (west of the Millstream deposit and south of the Sormany Road), which follows Arleau Brook to the lake and then by proceeding 0.5 km along a walkable trail to the lake's eastern outlet.

The limestone deposit(s) in this region is believed to be restricted to a 0.5 km wide zone extending over a strike length slightly in excess of 10 km between the Lower Tetagouche Lake and the Millstream River. The zone is believed to occupy the central portion of a plateau-like hill characterized by steep slopes on the west (i.e., elevation increases by 250 m over a lateral distance of 750 m) and gentler slopes to the east. The most significant drainage in the immediate vicinity, the South Branch of the Millstream River, consists of a series of interconnected ponds and swamp lands that tend to parallel the general east-west structural trend of the region. This stream system eventually drains into

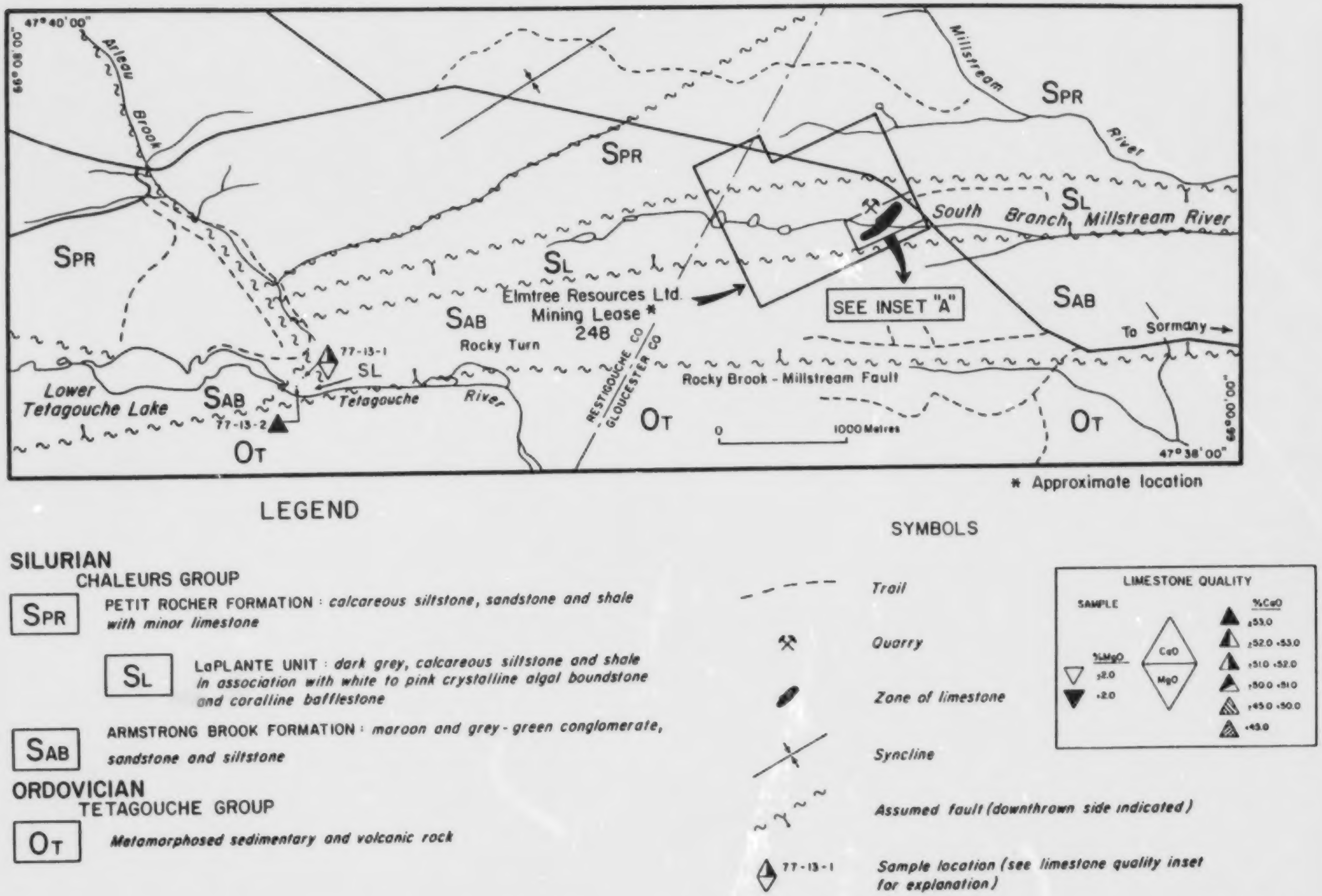

47°40'00"
66°08'00"
Arleau Brook
SPR
Millstream
SPR
River
SPR
SL
South Branch Millstream River
SL
Elmtree Resources Ltd. Mining Lease * 248
SEE INSET "A"
SAB
SAB
Rocky Turn
77-13-1
SL
Lower Tetagouche Lake
SAB
77-13-2
Tetagouche
River
OT
RESTIGOUCHE CO
GLOUCESTER CO
OT
Rocky Brook - Millstream Fault
0
1000 Metres
OT
To Sormany
66°00'00"
47°38'00"
* Approximate location
LEGEND
SILURIAN
CHALEURS GROUP
SPR
PETIT ROCHER FORMATION : calcareous siltstone, sandstone and shale with minor limestone
SL
LaPLANTE UNIT : dark grey, calcareous siltstone and shale in association with white to pink crystalline algal boundstone and coralline bafflestone
SAB
ARMSTRONG BROOK FORMATION : maroon and grey - green conglomerate, sandstone and siltstone
ORDOVICIAN
TETAGOUCHE GROUP
OT
Metamorphosed sedimentary and volcanic rock
SYMBOLS
Trail
Quarry
Zone of limestone
Syncline
Assumed fault (downthrown side indicated)
77-13-1
Sample location (see limestone quality inset for explanation)
LIMESTONE QUALITY
SAMPLE
%MgO
≥2.0
<2.0
CaO
MgO
%CaO
≥53.0
≥52.0 <53.0
≥51.0 <52.0
≥50.0 <51.0
≥45.0 <50.0
<45.0

Figure 2-10. Geology and limestone resources of the South Branch Millstream River and Lower Tetagouche Lake area, Gloucester County, New Brunswick. See Plate 89-265 for details.

the Millstream River to the east. The majority of the limestone deposit is situated in a densely forested area, with access limitations. An exception, however, is the extreme eastern end, which had been cut over prior to 1985. No significant habitation, other than a few hunting camps, occur within several kilometres of the deposit. Overburden cover is anticipated to be relatively thin throughout much of area, except in the South Branch Millstream River valley.

General Geology: The rocks in the South Branch Millstream River-Lower Tetagouche Lake region are separated into two distinct structural settings by the Rocky Brook-Millstream Fault. Rocks belonging to the Tetagouche Group occur south of the fault. They consist of highly deformed and sheared sedimentary and volcanic rocks of Ordovician age. Less deformed Silurian sedimentary rocks and overlying, flat-lying Carboniferous strata occur north of the fault. Collectively, the Silurian rocks consist of greenish to dark grey to reddish grey, calcareous slate (argillite), shale, sandstone (greywacke), conglomerate, limestone, and minor volcanics. They occupy the south limb of an asymmetrical, northeasterly trending synform and are believed to correlate with rocks of the Chaleurs Group exposed along the Baie des Chaleurs to the northeast, near Petit Rocher and Elmtree.

Detailed Geology: Limestone exposures in this area are typically white to pinkish white, fine- to medium-grained, and generally massive. Extensively recrystallized and highly fractured, they bear a striking resemblance to limestone deposits occurring in the LaPlante-Elmtree area, 80 km to the northeast. At this location, similar limestone-bearing rocks, informally referred to as the LaPlante unit (Noble 1985), are described as a sequence of allochthonous, reefal carbonate debris deposits associated with fine-grained, calcareous shales and siltstones of the Petit Rocher Formation.

Even though the Millstream River limestones are fossiliferous, attempts to date them accurately have not been undertaken. However, the strata apparently overlying the limestone has been assigned a Middle or Upper Silurian age (Hamilton 1965).

Exploration and Development: The South Branch Millstream River-Lower Tetagouche Lake limestones were first mapped by Davies in 1959, and described and sampled later by Hamilton and Webb in 1961 and 1977, respectively. It was not until 1982 that real interest was shown in these deposits when Elmtree Resources Limited staked the eastern portion of the limestone-bearing zone. Subsequent mapping, sampling, and limited drilling revealed a reasonably consistent high-grade calcic limestone with possible reserves estimated in excess of 4 million tonnes over an area of 6.5 ha. Encouraged by these results, the company applied for, and was granted, a 182.9 ha mining licence in 1983. This was later converted to a mining lease in 1989. Stone is presently quarried and transported to Elmtree's processing plant at the Elmtree Quarry site, 36 km by road to the northeast, where it is marketed mostly as smelter flux and agricultural lime.

Resource Evaluation: The somewhat remote location of the South Branch Millstream River-Lower Tetagouche Lake limestone deposits minimize the potential for land use conflicts. The Millstream River deposit, in particular, occupies the crest of a low hill and offers excellent quarry opportunities. Overburden in the area is relatively thin, and the South Branch Millstream River and its tributaries provide excellent drainage. A number of carbonate reefal structures have been identified in the immediate area and collectively are estimated to contain millions of tonnes of high-calcium stone projected to a depth of 30 m. These structures are believed to extend over a northeast-southwest strike length of 700 m and dip steeply to the north. Although a possible extension of this zone of reefal debris to the west and/or east is likely, it is anticipated that individual reefal components may have a somewhat sporadic distribution and may vary in size. Extensive mapping and sampling, supplemented by follow-up drilling, would be required in these areas to verify the full extent of the resource.

A small fault-bound wedge of limestone, occurring near the eastern outlet of Lower Tetagouche Lake, occupies the crest of a hill affording excellent quarry possibilites. The limestone found here is associated with dark grey, calcareous mudstone and is estimated not to exceed a thickness of a few tens of metres. Exposures in the area are limited. However, assuming the deposit is fairly consistent in terms of grade and thickness over several hectares, a speculative estimate in the order of 1 million tonnes of high-calcium stone is proposed for the Lower Tetagouche Lake deposit.

BLACK POINT-DICKIE COVE (21 0/16)

Silurian sedimentary and volcanic rocks are exposed along the coast of the Baie des Chaleurs in the Black Point-Dickie Cove area (Fig. 2-1), situated approximately 10 km northwest of the village of Jacquet River in Restigouche County. These rocks can be traced for about 12.5 km to the south (Fig. 2-2). Access to coastal exposures is excellent via several secondary roads and trails extending over open fields and lightly forested terrain north of coastal Highway No. 11.

South of the highway, the Silurian strata underlies densely forested terrain where access is somewhat more restrictive. The best exposures identified to date in this area occur along a northwest-trending power line, 3.25 km south of Dickie Cove and along the North and South Branches of Nash Creek, west of the Doyleville-Lorne Road.

Elevation gradually increases from north to south, ranging from about 15 m above sea level near the coast to approximately 750 m above sea level southwest of Lorne. The North and South Branches of Nash Creek and their tributaries form the most prominent drainage in the region. Overburden thicknesses throughout the area are estimated at less than 3 m. The region is sparsely populated. Significant settlement occurs adjacent to the coastal highway and at the village of Lorne.

Geology: The geology of the Black Point-Dickie Cove area has been incorporated into numerous regional geologic mapping projects (Alcock 1935; Griener 1970; Irrinki 1974; Davies 1979). More recently, the Silurian stratigraphy of Black Point has been mapped and studied in considerable detail by Lee and Noble (1977).

Limestone-bearing rocks belonging to the Limestone Point Formation (Noble 1976) dominate the Silurian stratigraphy in the area (Fig. 2-2). The formation is folded into a series of south-trending, anticlinal and synclinal structures of varying amplitude. These folds, coupled with the presence of several prominent north-trending faults and a well-developed cleavage in the rocks, indicate that the Silurian rocks in the area have undergone intense deformation.

West of Dickie Cove, Limestone Point Formation rocks are overlain by grey, nodular, silty limestone of the La Vieille Formation. These are, in turn, overlain by basaltic and andesitic volcanic rocks of the Bryant Point Formation, which forms the resistant coastal headland at Black Point. To the east, Limestone Point rocks are underlain by greyish brown shale, and grey-green siltstone interpreted as the Armstrong Brook Formation. The Armstrong Brook rocks rest on well-bedded, dark grey Ordovician limestones of the Matapedia Group.

Limestone Point rocks exposed west of Black Point, at Dickie Cove, Dickie Point, and Razor Cove, adequately display lithologic relationships typical of the formation elsewhere in northern New Brunswick. Collectively, these rocks consist of alternating thin- to thick-bedded sandstone, siltstone, and limestone. Limestones are dominated by skeletal calcarenites though calcilutites with in situ fossil allochems form lens-shaped masses within the sandstones and siltstones. The thickness of the sandstone and siltstone beds range from 5 to 50 cm, while that of the limestones is generally less than 20 cm. In all cases, bedding shows a significant lack of lateral persistence. Sedimentary structures such as mega-ripples, flaser bedding, and parallel- and cross-lamination are common throughout the clastic-carbonate sequence. Fossil remnants are often found oriented along the bedding planes in siltstone, and in situ fossil assemblages, consisting of brachiopods, corals, trilobites, and crinoids, are commonly preserved in the lens-shaped calcilutites. These features suggest a shallow-water, near-shore depositional environment characterized by periodic fluctuations in current flow. Such an environment does not appear to be favourable for the occurrence of limestone deposits of consistent grade and substantial thickness.

Resource Evaluation: Although reliable information is lacking, it is unlikely that Silurian limestones in the Black Point-Dickie Cove area would ever be developed. Its apparent association with a rock sequence dominated by clastics places a serious constraint on grade consistency. In some cases, limestone occurs as thick lenses; however, its distribution vertically and laterally is often irregular. It is generally contaminated with sufficient argillaceous and arenaceous material to render the deposit relatively insignificant as a viable source of limestone for most industrial purposes.

POINTE LA ROCHE (21 0/16)

Silurian limestones are well exposed on the coast of the Baie des Chaleurs at Pointe La Roche, about 6 km east of the Village of Charlo in Restigouche County (Fig. 2-1). At this location, limestone-bearing rocks of the La Vieille Formation form a band up to 1.2 km wide, traceable for several kilometres along the axis of a southwesterly plunging anticline (Fig. 2-11). The well-defined southern limit of the deposit is overlain by a conformable sequence of fluvial clastics and volcanic rocks referred to as the South Charlo Formation (Irrinki 1990) and rocks of the Bryant Point Formation (Noble 1976), respectively. The extent of the deposit to the north and west is largely inferred; however, the occurrence of scattered Bryant Point volcanics in these areas suggests a stratigraphic sequence similar to that exposed along its southern margin.

The northeastern portion of the limestone band underlies a gentle, seaward-sloping terrain characterized by a light forest cover and open to overgrown fields. Access to the northern half of the deposit is relatively easy via the main coastal Highway No. 11, and secondary roads that intersect it to the north and south. In contrast, the southwestern half of the band occurs in a densely forested area with access restricted to only a few driveable roads and several trails. The South Charlo River and its tributaries, coupled with a gradual south to north decrease in elevation, provide an excellent drainage network. The main populated centres are established adjacent to the main coastal highway.

Geology: Lithologically, rocks of the La Vieille Formation at Pointe La Roche are dominated by calcareous siltstones containing limestone nodules and lesser amounts of corralline, algal, and crystalline limestone. Nodular bedding is generally well developed showing little evidence of deformation. Thickness of individual beds range from 20 cm to 2 m. The formation is abundantly fossiliferous with massive tabulate corals, brachiopods, crinoids, stromatoporoids, and rugose corals. These are often preserved in an in situ growth position indicative of a quiet, deep-water depositional environment.

Resource Evaluation: A proper assessment of La Vieille limestone deposits at Pointe La Roche is hampered due to the lack of reliable data pertaining to its lateral and vertical extent, as well as its overall quality. Examination of coastal outcrops indicates that the limestone-bearing rocks are fairly typical of La Vieille strata found throughout the Baie des Chaleurs region. Therefore, it is anticipated that these limestones would yield relatively low grade material with CaO values seldom exceeding 45%.

Any proposed development of this resource would be somewhat restricted by potential land-use conflicts, particularly within a 1 km corridor north and south of the main coastal highway. Such limitations, however, can be expected to diminish farther to the southwest where quarry opportunities appear more favourable. However, the extent and quality of the resource in this area is open to speculation.

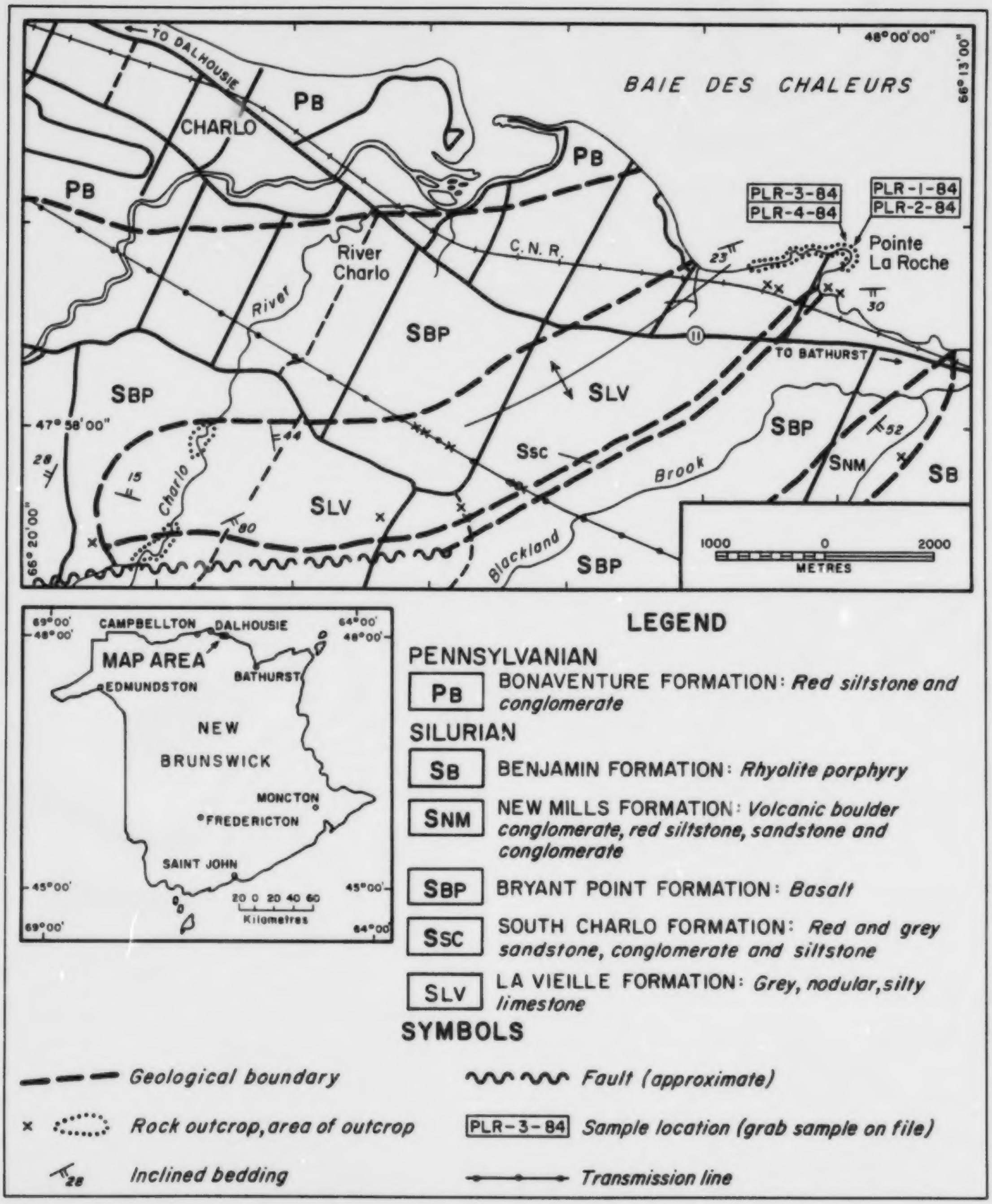

TO DALHOUSIE
48°00'00"
66°13'00"
BAIE DES CHALEURS
PB
CHARLO
PB
PB
PLR-3-84
PLR-4-84
PLR-1-84
PLR-2-84
Pointe
La Roche
River
Charlo
C. N. R.
23
River
30
SBP
11
TO BATHURST
SBP
SLV
47°58'00"
SBP
52
44
28
SSC
Brook
SNM
SB
15
Charlo
SLV
80
66°20'00"
Blackland
SBP
1000
0
2000
METRES
69°00'
48°00'
CAMPBELLTON
DALHOUSIE
64°00'
48°00'
MAP AREA
BATHURST
EDMUNDSTON
NEW
BRUNSWICK
MONCTON
FREDERICTON
SAINT JOHN
45°00'
45°00'
20 0 20 40 60
Kilometres
69°00'
64°00'
LEGEND
PENNSYLVANIAN
PB
BONAVENTURE FORMATION: Red siltstone and conglomerate
SILURIAN
SB
BENJAMIN FORMATION: Rhyolite porphyry
SNM
NEW MILLS FORMATION: Volcanic boulder conglomerate, red siltstone, sandstone and conglomerate
SBP
BRYANT POINT FORMATION: Basalt
SSC
SOUTH CHARLO FORMATION: Red and grey sandstone, conglomerate and siltstone
SLV
LA VIEILLE FORMATION: Grey, nodular, silty limestone
SYMBOLS
Geological boundary
Fault (approximate)
Rock outcrop, area of outcrop
PLR-3-84
Sample location (grab sample on file)
28
Inclined bedding
Transmission line

Figure 2-11. Geology of the Pointe La Roche-Charlo area, Restigouche County, New Brunswick (after Greiner 1970; and Irrinki 1976).

SOUTH CHARLO RIVER (parts of 21 0/15, 21 0/16 and 21 0/10)

A band of interbedded, calcareous siltstone and argillaceous limestone, up to 1200 m wide, can be traced over a strike length in excess of 50 km, from the mouth of the South Charlo River southwest to the Northeast Upsalquitch River in Restigouche County (Figs. 2-1, 2-12). This sequence of rocks, assigned to the La Vieille Formation by Irrinki (1990), are dominated by dark grey, thin- to medium-bedded, calcareous siltstone and fine-grained sandstone. Locally, very thin, wavy beds of grey, silty, nodular to massive, fossiliferous limestone constitute up to 30% of the formation. The remote location and poor access to most parts of the limestone band, coupled with the anticipation of low and inconsistent CaO grades, would tend to have a negative impact on exploration and potential development.

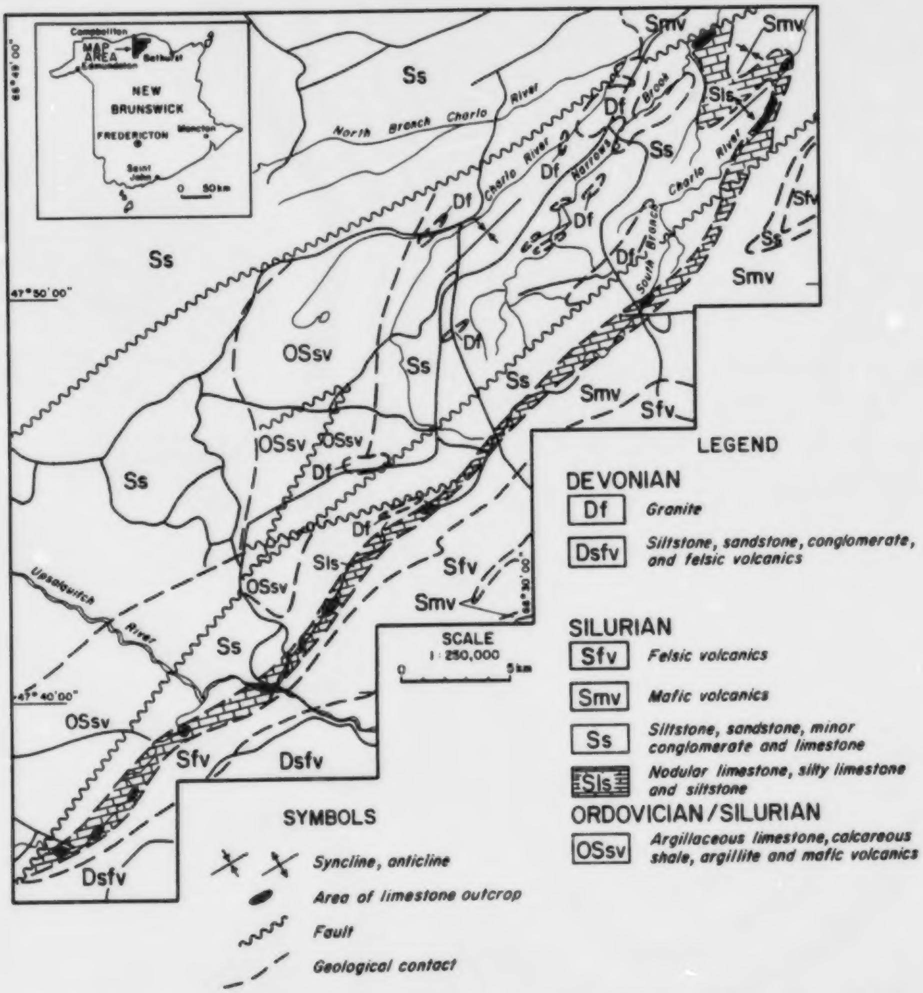

Campbellton
MAP AREA
Bathurst
Edmundston
NEW BRUNSWICK
FREDERICTON
Moncton
Saint John
0 50km
66°45'00"
47°50'00"
47°40'00"
66°30'00"
Ss
North Branch Charlo River
Charlo River
Narrows
Brook
South Branch Charlo River
Upsalquitch River
Smv
Sls
Df
Sfv
OSsv
Dsfv
SCALE
1:250,000
0 5km
LEGEND
DEVONIAN
Df Granite
Dsfv Siltstone, sandstone, conglomerate, and felsic volcanics
SILURIAN
Sfv Felsic volcanics
Smv Mafic volcanics
Ss Siltstone, sandstone, minor conglomerate and limestone
Sls Nodular limestone, silty limestone and siltstone
ORDOVICIAN/SILURIAN
OSsv Argillaceous limestone, calcareous shale, argillite and mafic volcanics
SYMBOLS
Syncline, anticline
Area of limestone outcrop
Fault
Geological contact

Figure 2-12. Geology and limestone resources of the Charlo River-Upsalquitch River area, Restigouche County, New Brunswick (after Irrinki 1976; and Davies 1977).

CHAPTER 3. LIMESTONE OCCURRENCES IN NORTHWESTERN NEW BRUNSWICK

Limestone-bearing rocks of northwestern New Brunswick are, for the most part, associated with a sequence of Upper Ordovician to Lower Silurian strata, collectively referred to as the Matapedia Group. These rocks occur in a zone up to 50 km wide extending southwest from Campbellton to Grand Falls and then south, straddling the Canada-United States border, to the Woodstock area. The most common characteristic of the Matapedia Group is its monotonous lithology, comprising hundreds of metres of grey, calcareous argillite, grey to black argillaceous limestone, and grey crystalline limestone, thinly and regularly interbedded with one another. Typically, the thin interbedded nature of the limestone, and its association with argillaceous material, results in poor quality deposits in comparison to other limestone resources elsewhere in the Province. Most deposits yield low MgO values accompanied by CaO values that seldom exceed 35% (see Plate 89-266 in pocket for details). Although higher grade deposits occur locally, it is important to note that these rocks have been folded, faulted, and sheared to varying degrees, further complicating accurate resource evaluation.

Despite the apparent widespread distribution of Ordovician-Silurian limestone in northwestern New Brunswick, only two representative occurrences are considered in the present resource inventory: 1) at Siegas in Madawaska County; and 2) north of Drummond, on the Salmon River in Victoria County (Fig. 3-1).

SIEGAS (21 O/4)

The Siegas limestone deposit is located in the midst of a farming community, 25 km northeast of the town of Grand Falls and immediately east of the Saint John River in Madawaska County. Excellent access to the deposit is provided by the Trans-Canada Highway and several secondary roads. The deposit underlies a gentle rolling topography, west of the Siegas River. Lower slopes and stream valleys are covered by glacial and glaciofluvial deposits ranging from 0 to 5 m thick. Scattered, deeply weathered outcrops are found only in the more elevated areas.

Geology: The Siegas area is underlain by marine sedimentary rocks ranging in age from Late Ordovician to Early Silurian (St. Peter 1977). The stratigraphy and distribution of rock types are summarized in Figure 3-2.

Limestone-bearing rocks, near Siegas, occur predominantly in the Carys Mills Formation (facies equivalent to the Matapedia Group; St. Peter 1977), and to a lesser extent

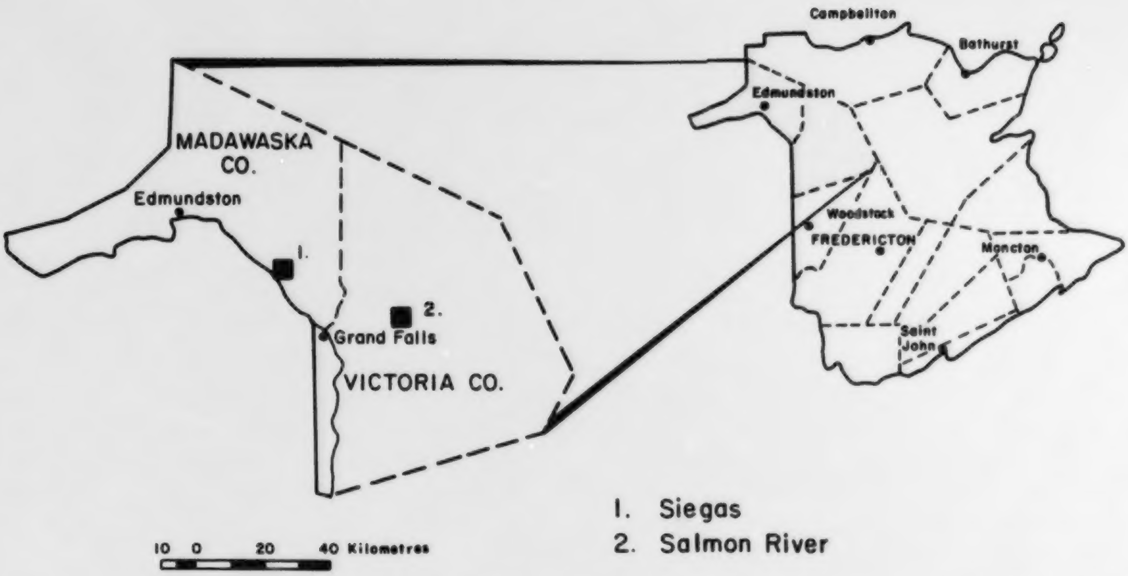

Campbellton
Bathurst
Edmundston
MADAWASKA CO.
Edmundston
1.
2.
Grand Falls
VICTORIA CO.
Woodstock
FREDERICTON
Moncton
Saint John
10 0 20 40 Kilometres
1. Siegas
2. Salmon River

Figure 3-1. Location of Ordovician-Silurian limestone occurrences in Madawaska and Victoria counties, northwestern New Brunswick.

in the overlying Siegas Formation. The Carys Mills Formation is dominated by two limestone members separated by a slate member (Hamilton-Smith 1970). It occupies the core of a northeast-trending syncline. The lowermost (limestone) member, consisting of interbedded limestone, sandstone, and slate, is about 215 m thick and is estimated to contain about 75% limestone. The middle (slate) member varies from 75 to 100 m thick. The upper (limestone) member has a thickness of about 75 m and is composed of interbedded limestone, slate, and sandstone. Locally, limestone accounts for up to 50% of the lithology.

In the limestone members, limestone beds vary from 1 to 40 cm thick, strike northeast and dip at 65° south to vertical. A well-developed cleavage is evident in the slate-dominated beds. The average insoluble content of the limestone is in the order of 20%.

Limestone in the Siegas Formation is lithologically similar to that in the underlying Carys Mills Formation. However, it accounts for less than 2% of the total formation thickness at this location (Hamilton-Smith 1970).

Exploration and Development: *Limestone* In 1945, six diamond-drill holes, totaling 307 m, were put down by the New Brunswick Department of Lands and Mines in conjunction with the Department of Agriculture to evaluate the limestone potential in the Siegas area. Calcium carbonate determinations were carried out for over 215 m of drill core at 3 m intervals.

Drillhole locations, and the results of limestone quality testing, are summarized on Plate 89-260. This preliminary evaluation was restricted to what is believed to be the western limits of the deposit. The potential for limestone-bearing horizons to the east cannot be ruled out, not discounting the possibility of pinch-out resulting from rapid facies change or other structural control(s).

Hematite About 20 years ago, an occurrence of hematite and manganiferous slate was discovered near St. Leonard, about 6 km southeast of Siegas. Subsequent trenching, sampling, and chemical analysis has confirmed the presence of hematite and minor siderite, and manganese mineralization occurring as coatings and concretions of manganite, pyrolusite, and psilomelane yielding Fe_2O_3 and MnO contents up to 39% and 7.7%, respectively (St. Peter 1978).

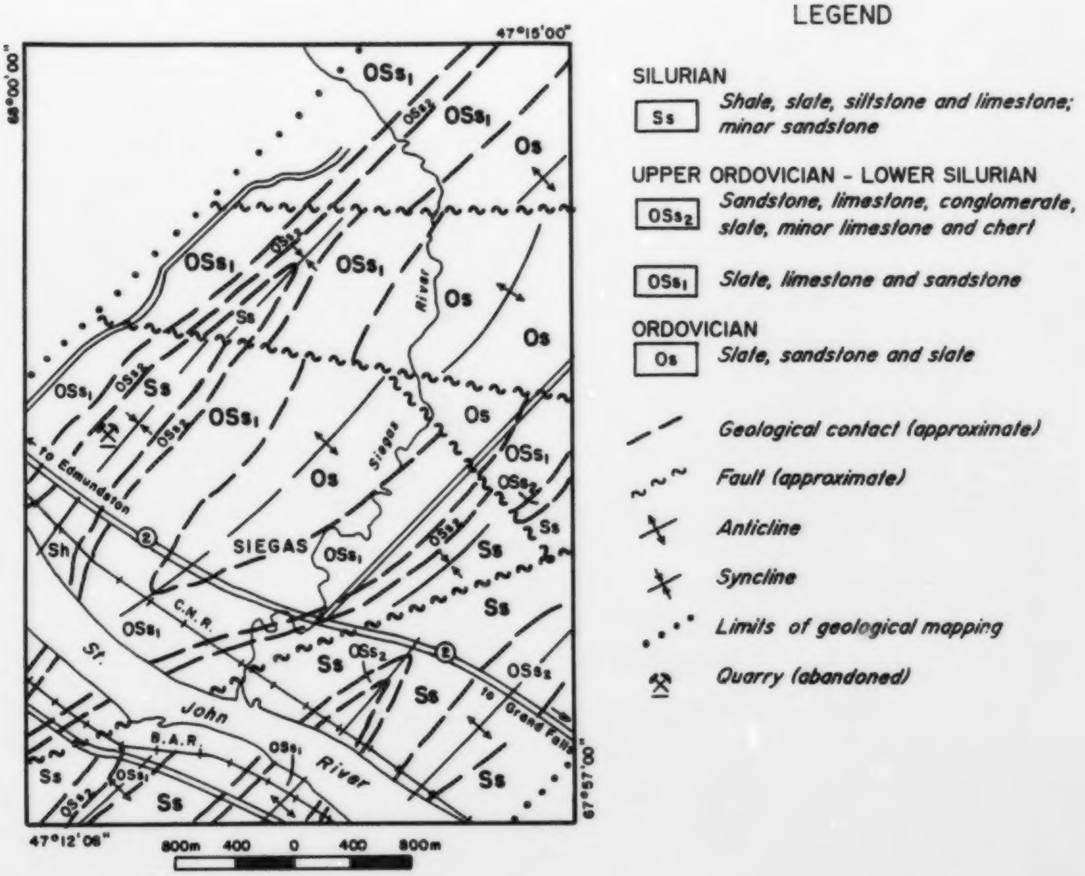

LEGEND
SILURIAN
Ss Shale, slate, siltstone and limestone; minor sandstone
UPPER ORDOVICIAN - LOWER SILURIAN
OSs2 Sandstone, limestone, conglomerate, slate, minor limestone and chert
OSs1 Slate, limestone and sandstone
ORDOVICIAN
Os Slate, sandstone and slate
Geological contact (approximate)
Fault (approximate)
Anticline
Syncline
Limits of geological mapping
Quarry (abandoned)
47°15'00"
68°00'00"
47°12'08"
67°57'00"
SIEGAS
Siegas
River
St. John River
to Edmundston
to Grand Falls
C.N.R.
B.A.R.
Sh
800m 400 0 400 800m

Figure 3-2. Geological map of the limestone deposit at Siegas, Madawaska County, New Brunswick (see Plate 89-260 for details).

Resource Evaluation: Drillhole data suggest that zones of limestone in the Siegas area are characterized by variable widths and a high frequency of interbedded slate. The lime content (CaO) in some of the more limy units evaluated is quite variable, ranging from 36 to 50%.

From past exploration efforts (Wright 1945; Hamilton 1965), limestone reserves have been estimated to be in the order of 1.2 million tonnes with an average grade of 48% CaO. Overburden thickness in the area is estimated not to exceed 3 m.

Despite favourable ground conditions and excellent access, the moderate to poor quality of the Siegas limestone coupled with tonnage limitations renders the deposit marginal as a priority target for future exploration and development as a source of industrial lime.

SALMON RIVER (21 O/4)

A few outcrops of limestone occur on the east bank of the Salmon River, just downstream from its confluence with Chambord Brook (Wilson 1990). The occurrence is situated about 16 km east of Grand Falls in Victoria County. It is accessible by the Highway 108 and several subsidiary roads north of New Denmark.

Geology: Limestone exposed at Salmon River forms part of an upfaulted block of Silurian strata situated in an area of several anastomosing faults between the McKenzie Gulch and Rocky Brook-Millstream fault systems (Fig. 3-3).

The limestone is hard, varying in color from reddish brown to pale grey to pink (Wilson 1990). Texturally, the reddish brown stone is composed of up to 80% fossil fragments in a micritic mud matrix. About 40% of the matrix is amorphous hematite, imparting a distinctive reddish colour to the rock. Fossil fragments are represented by corals, ostracods, brachiopods, and crinoids.

The grey to pink limestone is described as a wackestone containing 60-65% fossil fragments and 35-45% micritic matrix.

The faunal assemblage represented in the Salmon River limestone, suggests a Middle to Late Silurian age (Wilson 1990). The high degree of fossil fragmentation suggests reworking in a high-energy (e.g., reefal) depositional environment.

Exploration and Development: The Salmon River limestone occurrence was documented during a Department of Natural Resources and Energy regional mapping program in 1987. A grab sample has yielded the following values: 33.92% CaO, 1.28% MgO, 24.92% SiO_2, and 35.83% for others. The sample returned 32.97% acid insolubles.

Resource Evaluation: Initial indications are that the Salmon River limestone is of poor quality and limited extent. However, additional exploration is required for a proper evaluation.

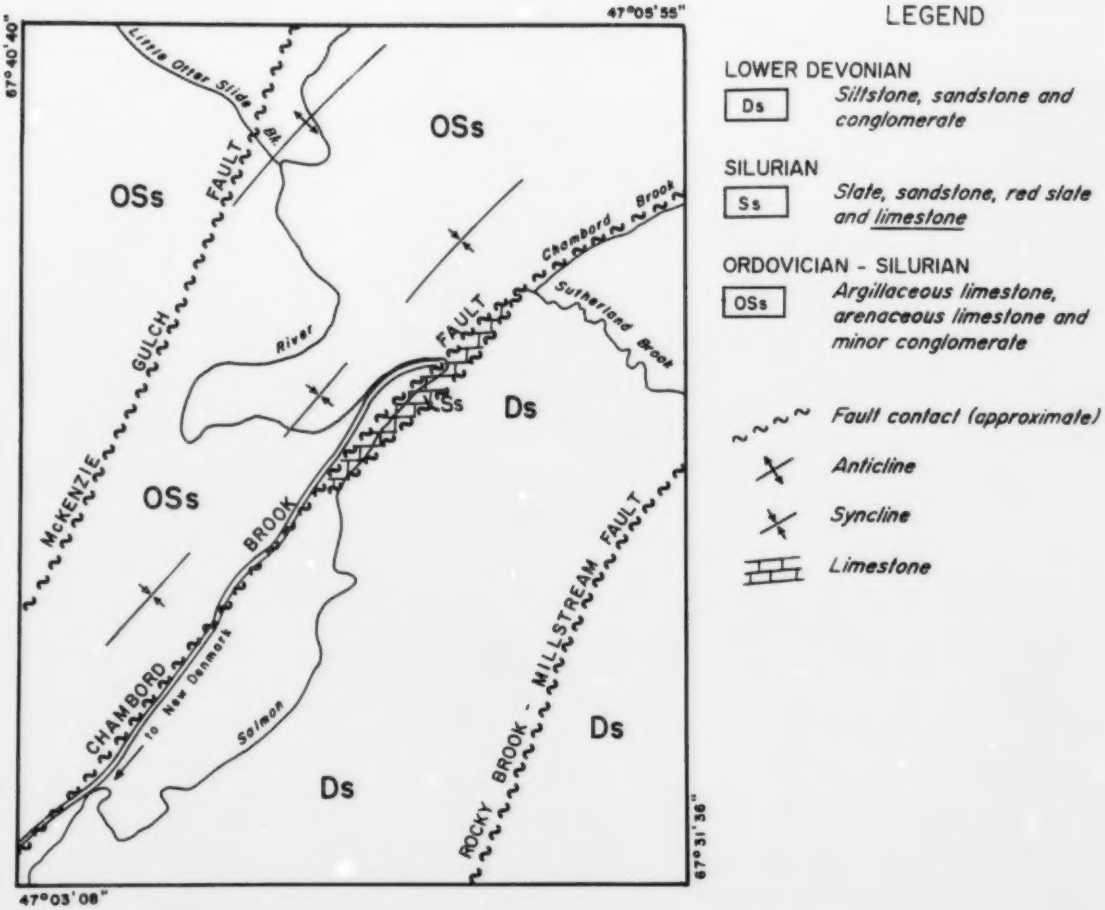

47°05'55"
67°40'40"
Little Otter Slide Bk.
OSs
OSs
OSs
FAULT
GULCH
McKENZIE
River
Chambord Brook
Sutherland Brook
FAULT
Ss
Ds
BROOK
CHAMBORD
to New Denmark
Salmon
Ds
Ds
ROCKY BROOK - MILLSTREAM FAULT
67°31'36"
47°03'08"
LEGEND
LOWER DEVONIAN
Ds
Siltstone, sandstone and conglomerate
SILURIAN
Ss
Slate, sandstone, red slate and limestone
ORDOVICIAN - SILURIAN
OSs
Argillaceous limestone, arenaceous limestone and minor conglomerate
Fault contact (approximate)
Anticline
Syncline
Limestone

Figure 3-3. Geology of the Salmon River limestone occurrence Victoria County, New Brunswick (after Wilson 1990). See Plate 89-259 for details.

CHAPTER 4. LIMESTONE OCCURRENCES IN WEST-CENTRAL NEW BRUNSWICK

Both Ordovician and Silurian age limestones are distributed in relatively small scattered deposits in west-central New Brunswick. With two exceptions in York County, most known deposits are situated 30 km northeast of Woodstock in Carleton County (Fig. 4-1), all within a 7 km radius of each other. Although most limestone resources in this area are associated with grey, calcareous sandstones and siltstones of the Silurian Smyrna Mills Formation, a few inliers of Ordovician argillite and associated argillaceous to siliceous limestone (Craig Brook Limestone) occur locally. East and south of Woodstock, limestone occurrences are restricted to an Ordovician inlier at Central Waterville and a slightly metamorphosed deposit of Silurian limestone at Dorrington Hill.

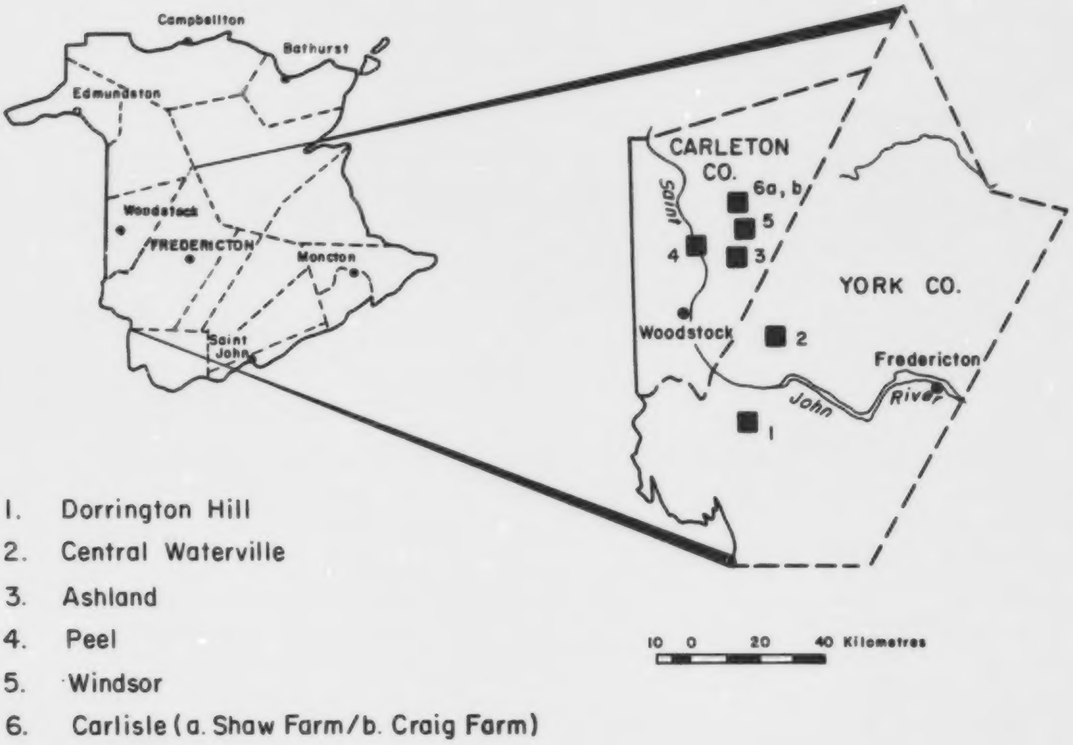

Campbellton
Bathurst
Edmundston
Woodstock
FREDERICTON
Moncton
Saint John
CARLETON CO.
Saint
6a, b
5
4
3
YORK CO.
Woodstock
2
Fredericton
John
River
1
10 0 20 40 Kilometres
1. Dorrington Hill
2. Central Waterville
3. Ashland
4. Peel
5. Windsor
6. Carlisle (a. Shaw Farm/b. Craig Farm)

Figure 4-1. Location of Ordovician-Silurian limestone occurrences in Carleton and York counties, west-central New Brunswick.

Limestone-bearing strata in this part of New Brunswick exhibits the effects of a relatively complex structural history. Intense folding and faulting is reflected in moderate to steep dips and boudinage of rock units at a number of locations. This results in somewhat small, isolated deposits, of limited lateral and vertical extent. Most limestones in the region are typically low in MgO and demonstrate a wide variation in CaO content (35 to 55%).

DORRINGTON HILL (21 G/14)

Dorrington Hill limestone, or more appropriately called Dorrington Hill marble, occupies a low-lying, swampy area on either side of Four Mile Brook, about 8 km northeast of Canterbury and about 2 km east of Dorrington Hill, in York County (Fig. 4-1). The occurrence is accessible by the Trans-Canada Highway, Highway 122, and several logging roads.

Geology: The deposit is included in strata belonging to the Hartin Formation, the uppermost stratigraphic unit of Silurian-Devonian rocks in this part of western New Brunswick (Venugopal 1979) (Fig. 4-2). The formation typically comprises sandstone and slate, minor conglomerate, limestone, and felsic volcanic rocks exposed along the flank of a north-plunging anticline. Limestone, a minor lithology commonly associated with lenses of conglomerate, is light to medium grey to pinkish, and locally light green in color, crystalline, and thinly bedded. Beds strike north and dip at steep angles. The limestone and associated clastics are intruded by gabbro. About 500 to 1000 m south of the limestone (marble) occurrence, associated sedimentary rocks have attained an andalusite-cordierite grade of metamorphism, being proximal to the younger Pokiok granite pluton.

Exploration and Development: Dorrington Hill limestone (marble) and other limestone occurrences in the vicinity have been known for over a century (Bailey 1884). In 1956, Strategic Metals Limited drilled three holes south of Canterbury. All three intersected limestone, but assays seldom exceeded 35% CaO (Patterson 1957). In 1957, York Marble Limited staked a property in the area that included the Dorrington Hill deposit. Limited quarrying was carried out for a few years. A sample collected across 15.2 m of strata exposed in the quarry has yielded 31.7% CaO, 1.5% MgO, 19.3% SiO_2, and 14.35% other constiuents (Hamilton 1965).

Resource Evaluation: It is presently not possible to evaluate the Dorrington Hill limestone (marble) deposit with any degree of accuracy due to insufficient information pertaining to its extent and quality of reserves. However, CaO content is expected to be variable.

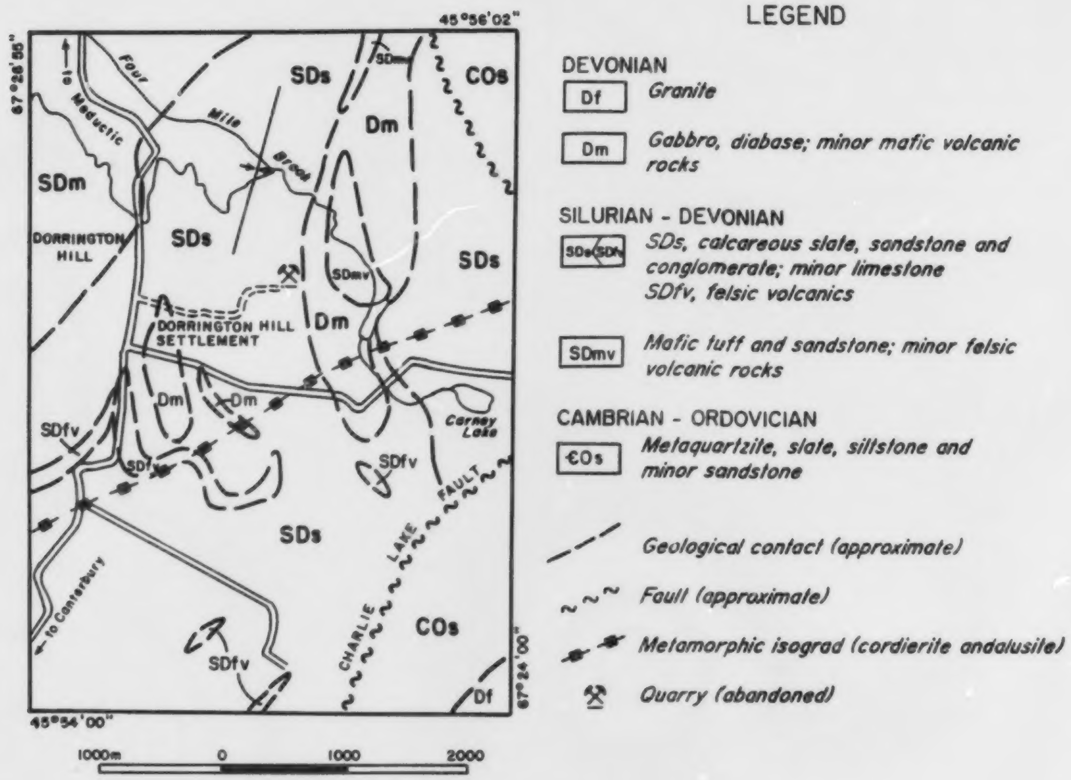

45°56'02"
67°26'55"
91
Four Mile Brook
Meductic
SDm
DORRINGTON HILL
SDs
SDm
COs
Dm
SDmv
DORRINGTON HILL SETTLEMENT
Dm
Dm
Dm
SDfv
SDfv
SDfv
Carney Lake
CHARLIE LAKE FAULT
SDs
COs
To Canterbury
SDfv
Df
45°54'00"
67°24'00"
1000m
0
1000
2000
LEGEND
DEVONIAN
Df Granite
Dm Gabbro, diabase; minor mafic volcanic rocks
SILURIAN - DEVONIAN
SDs/SDfv SDs, calcareous slate, sandstone and conglomerate; minor limestone
SDfv, felsic volcanics
SDmv Mafic tuff and sandstone; minor felsic volcanic rocks
CAMBRIAN - ORDOVICIAN
€Os Metaquartzite, slate, siltstone and minor sandstone
Geological contact (approximate)
Fault (approximate)
Metamorphic isograd (cordierite andalusite)
Quarry (abandoned)

Figure 4-2. Geology of the Dorrington Hill limestone deposit, York County, New Brunswick. See Plate 89-253 for details).

WATERVILLE (Central Waterville) (21 J/3)

The Waterville limestone deposit, also referred to as Central Waterville limestone deposit, occurs in a low-lying area about 22.5 km southeast of Woodstock, in the northwestern part of York County (Fig. 4-1). It is accessible by Highway 595, which forms the main transportation link between Fredericton and Woodstock via Pinder and Temperance Vale.

Scattered outcrops and several small depressions, representing either old workings or sink holes, occur in the area. The remains of an old pot kiln have been reported near the site of an abandoned quarry.

Geology: Limestone in the Waterville area is restricted to a thin-bedded, feldspathic greywacke-slate sequence referred to as the Belle Lake Slate (Venugopal 1979) (Fig.4-3). These rocks are highly folded and sheared.

The deposit is composed of two lenticular beds of limestone interbedded and/or intercalated with dark grey slate and a greyish green, feldspathic greywacke. The limestone is medium to light grey in color, fine- to medium-grained, massive and crystalline, containing slate fragments and minor pyrite mineralization. Individual limestone horizons range in width from 60 cm to about 26 m and have reported strike lengths of about 60 m. The beds generally strike to the northeast and dip at steep angles to vertical. Due to intense drag folding, the limestone beds show extensive thickening at fold hinges. Enclosing slates and greywackes are cut by numerous quartz-carbonate veins.

Although the Central Waterville limestone contains crinoid stems and other fossil fragments suggesting a Silurian age (Hamilton 1965), an assemblage of conodonts, identified by Nowland (1981), is contradictive, indicating a lower Middle Ordovician age (Venugopal 1979).

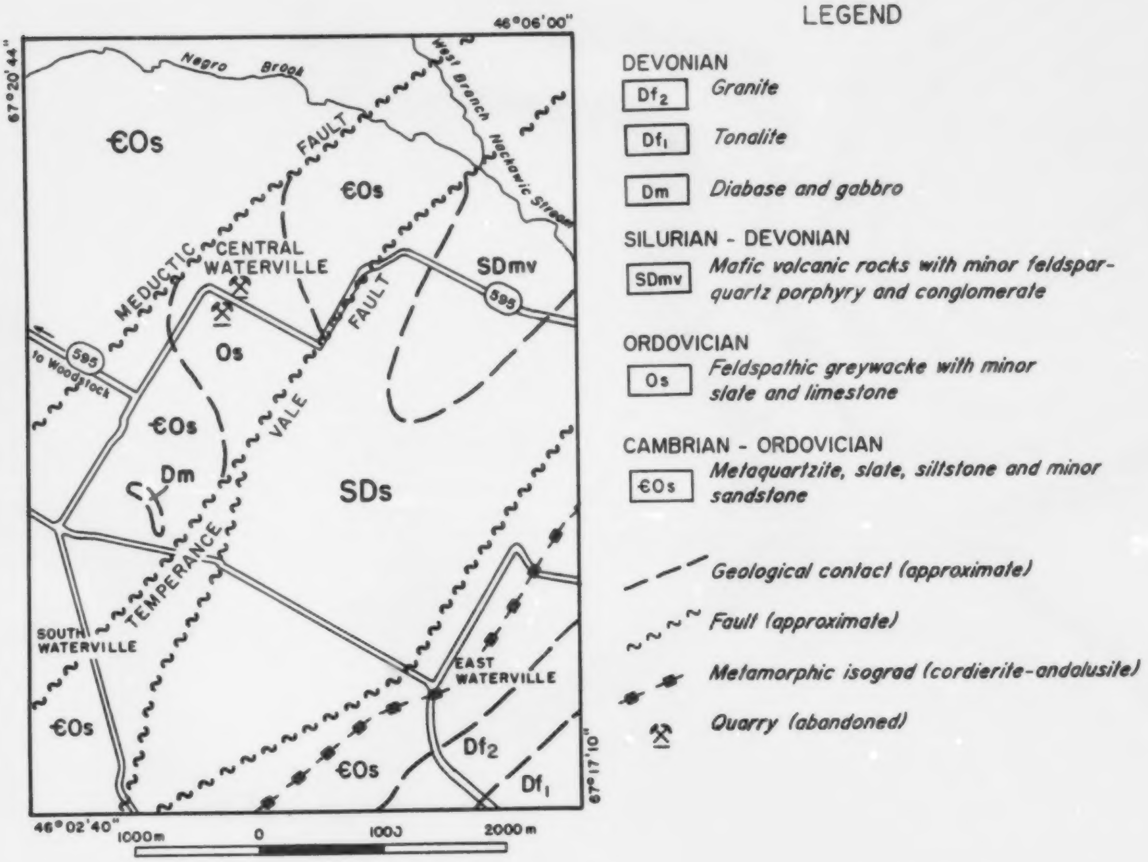

46°06'00"
67°20'44"
Negro Brook
West Branch Nackawic Stream
€Os
FAULT
MEDUCTIC
CENTRAL WATERVILLE
SDmv
595
to Woodstock
Os
VALE
FAULT
Dm
SDs
TEMPERANCE
SOUTH WATERVILLE
EAST WATERVILLE
Df2
Df1
67°17'10"
46°02'40"
1000m
0
1000
2000 m
LEGEND
DEVONIAN
Df2 Granite
Df1 Tonalite
Dm Diabase and gabbro
SILURIAN - DEVONIAN
SDmv Mafic volcanic rocks with minor feldspar-quartz porphyry and conglomerate
ORDOVICIAN
Os Feldspathic greywacke with minor slate and limestone
CAMBRIAN - ORDOVICIAN
€Os Metaquartzite, slate, siltstone and minor sandstone
Geological contact (approximate)
Fault (approximate)
Metamorphic isograd (cordierite-andalusite)
Quarry (abandoned)

Figure 4-3. Geology of the Central Waterville limestone deposit, York County, New Brunswick. See Plate 89-254 for details.

Exploration and Development: The Central Waterville limestone deposit has been documented in literature since 1884 (Bailey 1884). It was first worked for a short time during the early 1900's to produce agricultural lime. Numerous unsuccessful attempts were made by several individuals to continue quarry operations between 1932 and 1944. In 1945, quarrying was resumed following exploration by the Provincial Mines Branch. Twelve drill holes, totalling 497 m of drill core, were completed to determine the extent, grade, and tonnage of the deposit. York Marble Limited, established in 1956, operated a quarry until 1962, producing agricultural lime, poultry grit, terrazo chips, road metal, and a limited amount of facing stone. What remains of the deposit has sparked only cursory interest since that time.

Resource Evaluation: The deposit at Central Waterville contains high-calcium limestone that may be satisfactory for several industrial applications. It is estimated that the deposit may contain reserves in the order of 40 000 tonnes (Hamilton 1965), with an average grade of 54.4% CaO to a depth of about 30 m. Despite the fact that the deposit appears to be of a high quality and is reasonably accessible, its relative tonnage limitations would restrict its development potential without additional exploration.

ASHLAND (21 J/6)

A limestone deposit, located about 2.4 km east of the village of Ashland and 8 km east of Hartland in Carleton County, occupies a low-lying area south of the Becaguimec Stream. The deposit is accessible by Highway 104 to Coldstream and then via 5 km of combined secondary roads and trails (Fig. 4-1). It covers an area less than 0.5 ha, and is exposed in an abandoned and overgrown quarry, historically referred to as the Welsh quarry.

Geology: The Ashland deposit occupies one of the few Ordovician inliers (Fig. 4-4) of the region. The rock at the quarry is a carbonaceous, stylolitic, finely crystalline to silty limestone interbedded with calcareous slate. The limestone is massive, dark grey, and contains calcite stringers, crinoid stems, and broken brachiopod shells. The rock is highly fractured and sheared.

Anderson (1968) and Hamilton (1965) first considered these rocks to be of Silurian age. However, according to St. Peter (1982), conodonts extracted from the limestone at the quarry yield a Middle Ordovician age (early Llandeilian).

Exploration and Development: Intermittent quarrying and limestone calcining at Ashland was apparently underway during the latter part of the nineteenth century (Bailey 1884). In the mid 1950's, Stratmat Limited put down five diamond-drill holes to further assess the deposit's development potential. Specific information pertaining to the results of the drill program is not available. However, Hamilton (1965) states that two holes, located

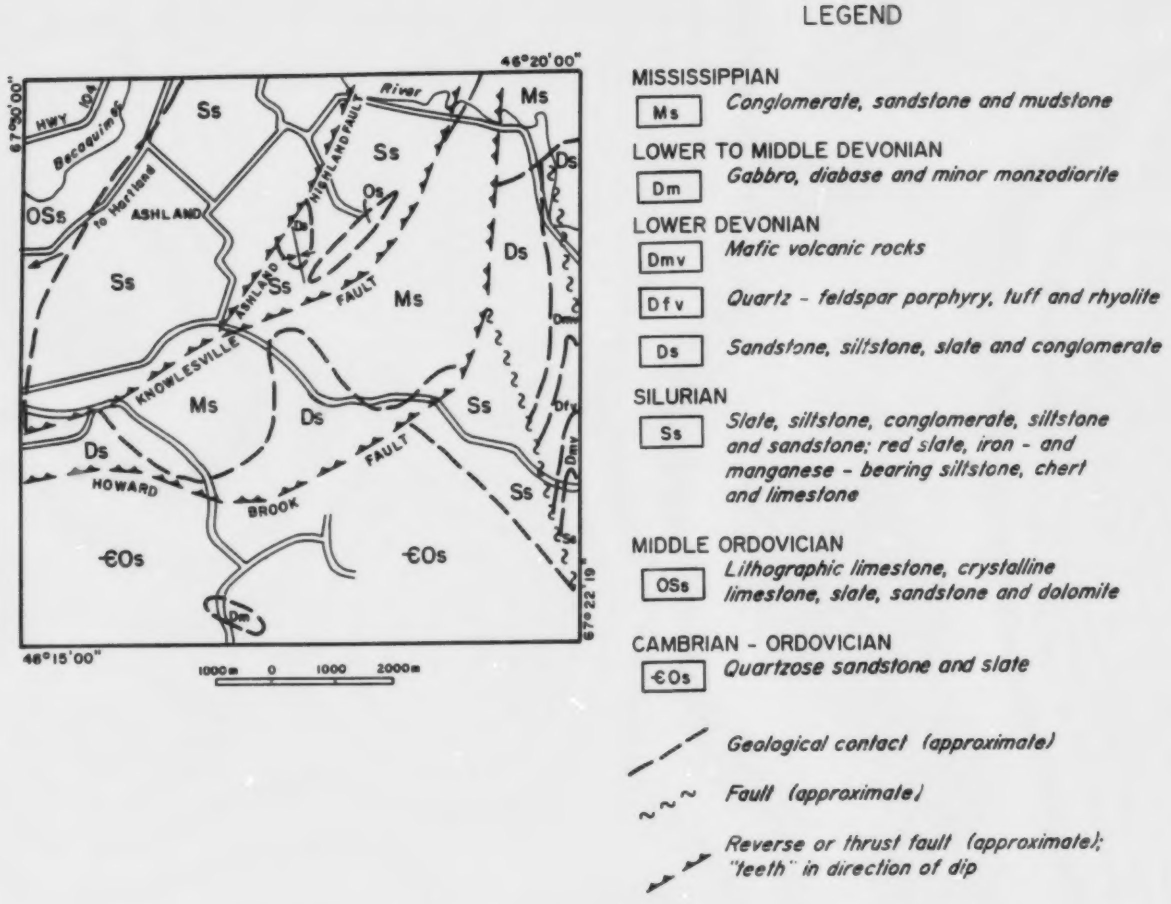

LEGEND
46°20'00"
67°30'00"
HWY 104
Becaguimec
to Hartland
ASHLAND
OSs
Ss
River
HIGHLAND FAULT
ASHLAND
FAULT
Ms
Ds
Os
Dm
Dmv
Dfv
KNOWLESVILLE
FAULT
HOWARD
BROOK
€Os
46°15'00"
67°22'19"
1000m 0 1000 2000m
MISSISSIPPIAN
Ms Conglomerate, sandstone and mudstone
LOWER TO MIDDLE DEVONIAN
Dm Gabbro, diabase and minor monzodiorite
LOWER DEVONIAN
Dmv Mafic volcanic rocks
Dfv Quartz - feldspar porphyry, tuff and rhyolite
Ds Sandstone, siltstone, slate and conglomerate
SILURIAN
Ss Slate, siltstone, conglomerate, siltstone and sandstone; red slate, iron - and manganese - bearing siltstone, chert and limestone
MIDDLE ORDOVICIAN
OSs Lithographic limestone, crystalline limestone, slate, sandstone and dolomite
CAMBRIAN - ORDOVICIAN
€Os Quartzose sandstone and slate
Geological contact (approximate)
Fault (approximate)
Reverse or thrust fault (approximate); "teeth" in direction of dip

Figure 4-4. Geology of the Ashland limestone deposit, Carleton County, New Brunswick. See Plate 89-256 for details.

limestone-bearing zone pinches out or may be truncated by a fault in this area. A composite chip-sample taken across a width of about 18 m from the quarry floor has yielded the following: 45.2% CaO, 2.1% MgO, 10.8% SiO_2, and 3.8% for others.

Resource Evaluation: At Ashland, limestone is exposed only in the south wall of the old Welsh quarry. Most of the area surrounding the quarry is covered by overburden in excess of 3 m thick. Despite the deposit's reasonable access, its apparent limited reserves, and its low lime content make it an unlikely candidate as a high quality/large tonnage source of limestone.

CARLISLE (21 J/6)

The Carlisle limestone deposit occurs in two Ordovician inliers immediately north of the farming community of Carlisle, situated about 32 km northeast of Woodstock in Carleton County (Fig 4-1). The deposits are separate and are commonly referred to as the Craig Farm limestone and Shaw Farm limestone. They are accessible by the Trans-Canada Highway and several connecting provincial highways northeast of Hartland.

Geology: The Carlisle area is underlain by folded sedimentary and volcanic rocks ranging in age from Ordovician to Devonian (Fig. 4-5). Limestone deposits of the area are represented by the Craig Brook Limestone (Ordovician age) and the Smyrna Mills Formation (Silurian age) and have been described by St. Peter (1982).

Craig Farm Deposit Limestone at Craig Farm forms a lenticular mass about 540 m long with a maximum width of 120 m. It outcrops along the banks of the North Becaguimec River and along an adjacent highway, approximately 300 m north of the confluence of the river and Craig Brook (Fig. 4-5). The main part of the deposit underlies the road and flood plain of the river. The river roughly defines the deposit's easternmost boundary.

Lithologically, the Craig Farm deposit consists of interstratified, silty, lithographic limestone and dark grey calcareous slate, with interbeds of grey, crystalline limestone, carbonaceous quartzose sandstone, banded chert, and dolomite (St. Peter 1982).

The lithographic limestone occurs in light grey weathered units ranging from 1 to 50 cm thick. The rock, characterized by calcite veining and well-developed graphitic stylolites is interbedded with dark grey, calcareous slate composed of silt-sized carbonate grains containing oolites and microcrenulated and laminated calcite clasts.

The grey crystalline variety of limestone commonly occurs in beds 10 cm to several metres thick. It consists of about 50% carbonate sand set in a blocky calcite cement. The sand clasts mostly comprise micritic pellets and/or intraclasts with minor fragments of oolites, bryozoans, coral debris(?), and microlaminated calcite. The rock also contains an abundance of conodonts.

On the North Becaguimec River, about 200 to 400 m north of its confluence with Craig Brook, lithographic limestone and calcareous slate are found interbedded with carbonaceous, quartzose sandstone, light and dark grey, parallel-laminated chert, and minor crystalline dolomite. The carbonaceous sandstones contain poorly preserved graptolites.

Shaw Farm Deposit The Shaw Farm limestone deposit, situated a few hundred metres west of the Craig Farm deposit (Fig. 4-5), also occurs as a lenticular body having an approximate north-south strike length of 1800 m and a maximum width of about 95 m.

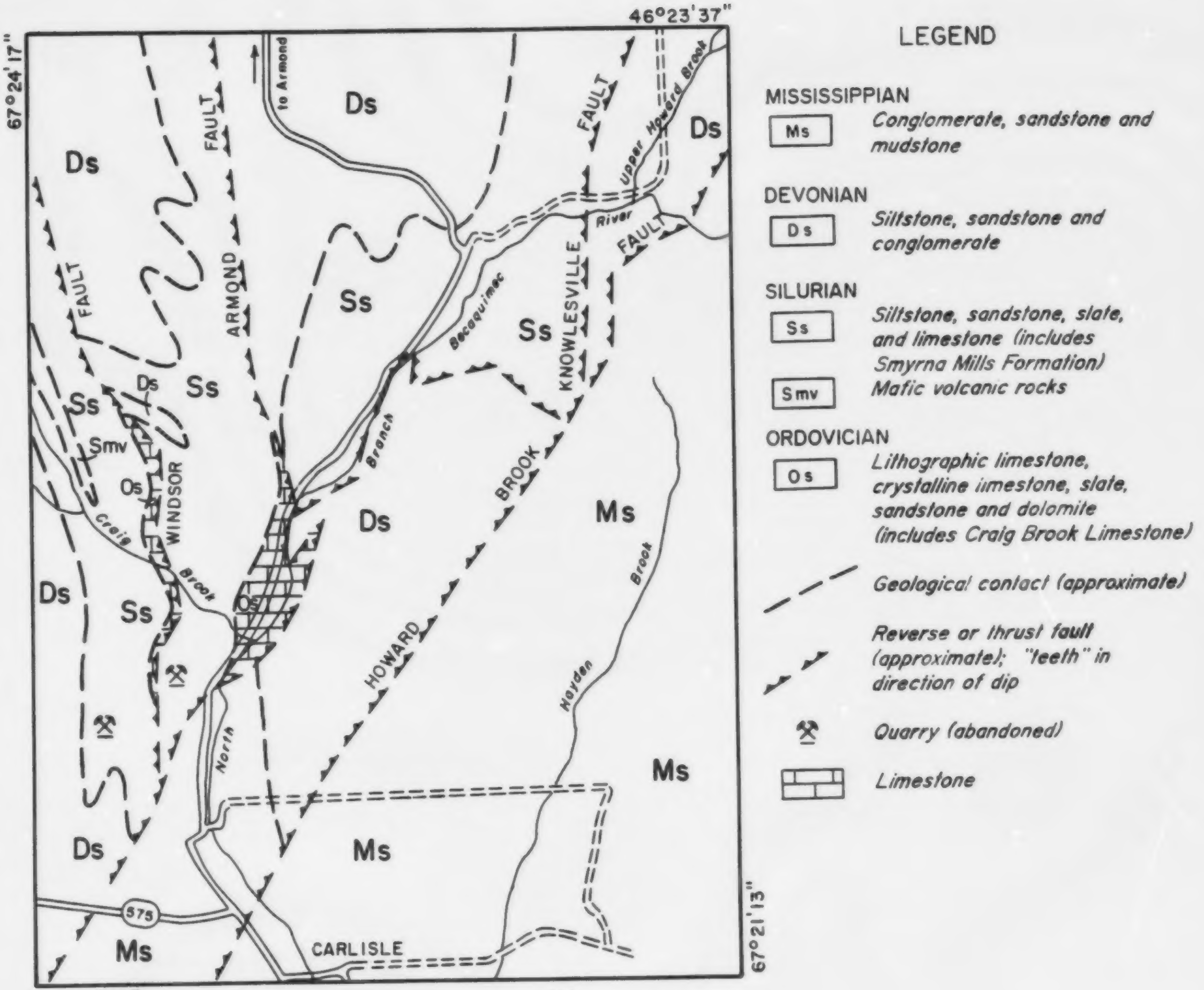

46°23'37"
67°24'17"
67°21'13"
46°20'49"
1000 metres
0
1000
to Armond
Ds
Ss
Smv
Os
Ms
FAULT
ARMOND
WINDSOR
KNOWLESVILLE
HOWARD
BROOK
Upper Howard Brook
River
Becaguimec
Branch
Craig
Brook
North
Hayden
Brook
575
CARLISLE
LEGEND
MISSISSIPPIAN
Ms
Conglomerate, sandstone and mudstone
DEVONIAN
Ds
Siltstone, sandstone and conglomerate
SILURIAN
Ss
Siltstone, sandstone, slate, and limestone (includes Smyrna Mills Formation)
Smv
Mafic volcanic rocks
ORDOVICIAN
Os
Lithographic limestone, crystalline limestone, slate, sandstone and dolomite (includes Craig Brook Limestone)
Geological contact (approximate)
Reverse or thrust fault (approximate); "teeth" in direction of dip
Quarry (abandoned)
Limestone

Figure 4-5 Geology of the Carlisle limestone deposit, Carleton County, New Brunswick. For details see Plate 89-257.

The limestone displays ample evidence of folding, fault disruption, and pinch and swell. This imparts a distinctive blocky appearance to most exposures–a feature commonly characteristic of sedimentary boudinage.

These rocks are lithologically similar to those found nearby at Craig Farm. They are best exposed in the southern half of the deposit at two abandoned quarries situated south of Craig Brook (Hamilton 1965). Farther to the southwest, limestone of Smyrna Mills Formation (Silurian age) is exposed in a small quarry.

According to St. Peter (1982), the basal (eastern) contacts of the two Craig Brook Limestone sequences, in the Carlisle area, are tectonic (thrust fault contacts). The upper (western) contacts are interpreted as unconformable. The limestone contains abundant shelly and graptolitic fauna and a significant conodont assemblage yields a Middle Ordovician age (Nowlan 1981).

Exploration and Development: Interest in the Carlisle limestone deposits dates back to the early nineteenth century when two quarries were in operation (Bailey 1886). These workings were eventually abandoned, leaving behind little or no trace of activity.

In 1955, Stratmat Limited carried out detailed geological investigations in the area that included mapping and a subsequent drilling program. Twenty-five diamond-drill holes, totalling over 2600 m of core were completed on the Craig Farm and Shaw Farm deposits (see Plate 89-257 in pocket for details). All holes were drilled at an angle of 45° and those intersecting limestone were sampled at approximately 7.5 m intervals.

At Craig Farm, drilling was reasonably successful in outlining a low-grade limestone with a strike length of about 365 m, and a maximum width of 80 m. The deposit was evaluated to a depth of approximately 60 m and was estimated to contain about 4 000 000 tonnes, grading less than 30% CaO and 35% SiO_2.

Drilling on the the Shaw Farm property verified a limestone deposit with an estimated strike length of 520 m and a width of 27 m. Reserves were estimated at 1 460 000 tonnes to a depth of about 60 m, with an average grade of 50.8% CaO and 4.4% SiO_2.

Southwest of the Craig and Shaw farm properties, a single hole (DH-38) intersected about 148 m of Smyrna Mills Formation limestone before drilling was terminated at a depth of 160 m. Given the steep-dipping nature of the deposit, this intersection is calculated to represent a true thickness of about 98 m, having an average grade of 50.9% CaO, 0.62 MgO, 2.9% SiO_2, and 5% other oxides.

The Shaw Farm area limestone deposits were re-evaluated by Lockhart in 1978. It was speculated that if one were to assume a strike length of 365 m to the north and an equivalent length to the south of DH-38, an estimate of 6 million tonnes to a depth of 60 m could be projected for this part of the deposit. Coupled with reserve estimates from the

Shaw Farm deposit to the north, a total possible reserve in the order of 8 to 9 million tonnes, with an estimated grade of 50% CaO, 2% SiO_2, and 6% others, would seem reasonable for the limestone deposits at this location.

Resource Evaluation: The Carlisle limestone deposits are easily accessible by road and are situated in a sparsely populated area. Of the two deposits noted, the Craig Farm deposit probably has the least chance of ever being developed. Low-grade material, limited recoverable reserves, and the fact that a majority of the deposit underlies the flood plain of the Becaguimec River and an adjacent highway, are among the most serious development constraints.

In contrast, the Shaw Farm deposit is characterized by better quality material (50% CaO) but reserves in the explored northern portion of the deposit (Ordovician) appear to be limited to less than 1.5 million tonnes. However, there remains some potential for several million additional tonnes in the relatively unexplored southern portion of the deposit (Silurian). Quarry opportunities appear good given the property's hillside location and the relatively thin veneer of overburden (0.5 to 3.0 m thick) covering the bedrock of the area.

PEEL (21 J/6)

There is a limestone occurrence situated just east of the Saint John River, 6.5 km north of Hartland at Peel, in Carleton County. It can be reached via the Trans-Canada Highway, Highway 105, and a secondary road connecting the communities of Peel and Landsdowne (Fig. 4-1).

Geology: The Peel limestone is part of a mixed sedimentary-volcanic sequence consisting of interbedded green and red slate, grey-green siltstone and calcareous to quartzose sandstone, and mafic volcanic rocks (Fig. 4-6). Limestone-bearing rocks occur in the core of a regional synclinal structure. They strike almost due north and dip 60 to 70° west.

The best limestone exposure at Peel is found just north of the Peel-Landsdowne road in a small abandoned quarry. A 2.5 m thick section of medium to dark grey, fine-grained, and massive limestone displaying a medium light grey, weathered surface occurs at this location. The rock contains abundant fossil fragments including trilobites, ostracods(?), crinoid stems, and corals. Fossils are commonly replaced by calcite. The Peel limestone is bellieved to be similar to that found associated with the Smyrna Mills Formation. Smyrna Mills rocks occur extensively throughout the region.

Exploration and Development: No record of exploration exists for the Peel deposit. A representative sample of limestone from the quarry has been analysed and yielded:

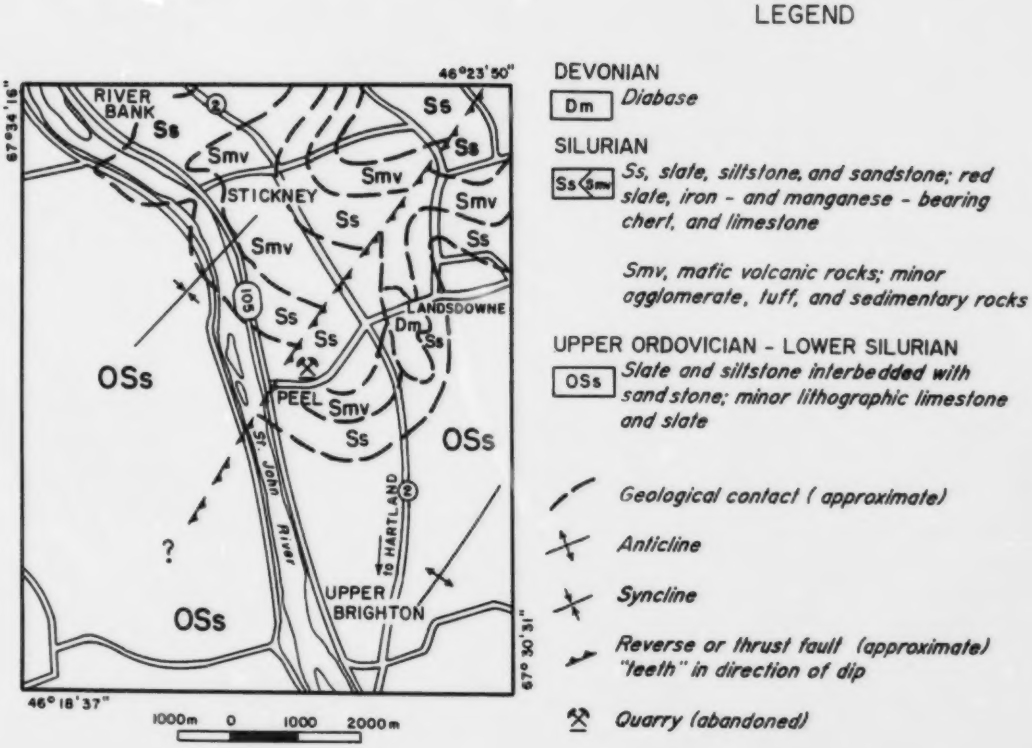

LEGEND
DEVONIAN
Dm Diabase
SILURIAN
Ss Smv Ss, slate, siltstone, and sandstone; red slate, iron - and manganese - bearing chert, and limestone
Smv, mafic volcanic rocks; minor agglomerate, tuff, and sedimentary rocks
UPPER ORDOVICIAN - LOWER SILURIAN
OSs Slate and siltstone interbedded with sandstone; minor lithographic limestone and slate
Geological contact (approximate)
Anticline
Syncline
Reverse or thrust fault (approximate) "teeth" in direction of dip
Quarry (abandoned)
46°23'50"
67°34'16"
46°18'37"
67°30'31"
RIVER BANK
STICKNEY
LANDSDOWNE
PEEL
UPPER BRIGHTON
TO HARTLAND
St. John River
Ss
Smv
Dm
OSs
?
2
105
1000m 0 1000 2000m

Figure 4-6. Geology of the Peel limestone deposit, Carleton County, New Brunswick. See Plate 89-255 for details).

87.78% $CaCO_3$, 6.05% $MgCO_3$, 4.70% SiO_2, and 0.95% for others (Hamilton 1965). Analysis of a sample from a nearby outcrop returned 80.69% $CaCO_3$, 4.50% $MgCO_3$, 12.55% SiO_2, and 1.60% for other constituents (Hamilton 1965).

Resource Evaluation: Grass roots exploration, including detailed mapping, trenching, drilling, and chemical analyses, are clearly required to fully assess the development potential of the Peel area limestone. However, it is anticipated that the deposit may be typical of other Silurian limestone deposits in this part of New Brunswick, comprising lower grade material of limited extent.

WINDSOR (21 J/6)

A lenticular body of limestone occurs in a sparsely populated area less than 1 km east of the community of Windsor, in Carleton County (Fig. 4-1). The deposit, situated about 13 km northeast of Hartland, is accessible via the Trans-Canada Highway and several provincial secondary roads. It occurs in an area dominated by hilly topography with extensive open fields supporting several large farms. The area in the immediate vicinity of the deposit is drained by a network of streams flowing south and west.

The limestone forms a band about 75 m wide by 650 to 700 m long. It is best exposed in the abandoned Orser quarry, situated south of Merkey Brook and about 450 m east of a highway intersection at Windsor (Fig. 4-7). Although the deposit appears to pinch out about 200 m south of the quarry, the presence of what appears to be a sinkhole farther south suggests that it may extend an additional few hundred metres. The deposit can be traced for a distance of about 350 m north of the quarry to Merkey Brook, beyond which it is covered by swampy terrain.

Geology: The Windsor area is underlain by faulted Silurian and Devonian sedimentary and volcanic rocks (Hamilton 1965; St. Peter 1982; Fig. 4-7).

Limestone occurs predominantly in the uppermost part of the Smyrna Mills Formation (St. Peter 1982). This formation comprises green and grey, calcareous to quartzose sandstone, green and grey siltstone, green and red slate, pebble conglomerate, and limestone.

Smyrna Mills limestone tends to be fine-grained, light to medium grey, and often displays a light brown weathered appearance. It is commonly interbedded with varying amounts of slate and siltstone, and is partially recrystallized. It contains a variety of fossils, including fragments of crinoids, brachiopods, gastropods, trilobites, conodonts, and corals. Several well-documented fossil and conodont localities within the formation (Pavlides and Berry 1966; St. Peter 1982) suggest that these rocks are of Silurian age (Lower Llandoverian to Ludlovian).

The rocks in the Windsor area are upright, tightly folded and plunge gradually to the north. Several regional fault systems (i.e., the Ashland Highland Fault and Windsor Fault) traverse the area, imparting several structural controls on the distribution of the limestone-bearing strata.

Exploration and Development: In the mid-1950's, Stratmat Limited conducted a drilling program to evaluate the quality and extent of the Windsor limestone deposit. This program consisted of 11 diamond-drill holes, totalling 812 m. The results have been summarized on Plate 89-258.

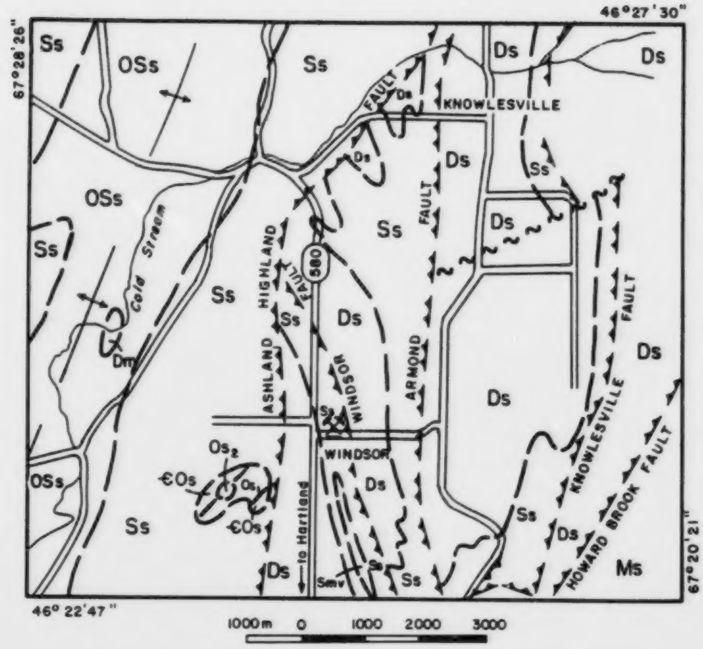

46°27'30"
67°28'26"
67°20'21"
46° 22'47"
Ss
OSs
Ds
Dm
Os₂
€Os
Os₁
Smv
Ms
KNOWLESVILLE
WINDSOR
Cold Stream
to Hartland
580
HIGHLAND FAULT
ASHLAND
WINDSOR
ARMOND
FAULT
KNOWLESVILLE FAULT
HOWARD BROOK FAULT
1000m 0 1000 2000 3000
LEGEND
MISSISSIPPIAN
Ms Conglomerate, sandstone, and mudstone
LOWER TO MIDDLE DEVONIAN
Dm Gabbro, diabase and minor monzodiorite
LOWER DEVONIAN
Ds Sandstone, siltstone, slate and conglomerate
SILURIAN
Ss Smv Ss, slate, siltstone, conglomerate; sandstone; red slate, iron - and manganese - bearing siltstone, chert, and limestone
Smv, mafic volcanics
UPPER ORDOVICIAN - LOWER SILURIAN
OSs Slate, siltstone, and sandstone; minor lithographic limestone
UPPER ORDOVICIAN
Os₂ Limestone, and conglomerate
MIDDLE ORDOVICIAN
Os₁ Lithographic limestone, crystalline limestone,, slate, sandstone and dolomite
CAMBRIAN - ORDOVICIAN
€Os Sandstone and slate
Geological contact (approximate)
Fault (approximate)
Reverse or thrust fault (approximate); "teeth" in direction of dip
Quarry (abandoned)

Figure 4-7. Geology of the Windsor limestone deposit, Carleton County, New Brunswick. See plate 89-258 for details).

According to Stratmat, the limestone zone was found to have a strike length of about 590 m and an average width of about 565 m. When calculated to a depth of about 60 m, an estimated reserve of 4 630 000 tonnes with a weighted average grade of only 39% CaO and 15.36% SiO_2 was thought to be representative of the deposit. Further investigation was carried out within a short distance of the old Orser quarry. Drilling and related exploration indicated a general decrease in ore grade toward the north and south. The property was subsequently abandoned.

After nearly 20 years of no significant exploration activity, Lockhart Exploration Services Ltd. initiated a re-evaluation of the Windsor deposit in the mid-1970's with the apparent intention of developing a market for agricultural limestone in west-central New Brunswick and northern United States. During the re-evaluation process, a smaller area was considered and a reserve calculated at 1 480 000 tonnes to a depth of 60 m, having an average grade of 49.6% CaO, a trace of $MgCO_3$ and 6.8% SiO_2 (Lockhart 1978).

Resource Evaluation: The Windsor limestone deposit is favourably located regarding access and potential markets. As far as quality and tonnage are concerned, three estimates have been compiled from various sources. All are based on the results of the 1957 Stratmat exploration program and each has been calculated to a depth of about 60 m. Limestone estimates include: 1) 4 631 666 tonnes, at an average grade of 38.99% CaO and 15.36% SiO_2 (Harvey 1957); 2) 1 600 000 tonnes, at an average grade of 42.23% CaO (Hamilton 1965); and 3) 1 480 000 tonnes, at an average grade of 49.6% CaO (Lockhart 1978).

CHAPTER 5. LIMESTONE OCCURRENCES IN SOUTHWESTERN NEW BRUNSWICK

Significant Ordovician-Silurian limestone-bearing strata is relatively scarce in southwestern New Brunswick. Two of the most notable occurrences are situated on the coast of the Bay of Fundy near Letang and on Frye Island, in Charlotte County (Fig. 5-1).

LETANG-FRYE ISLAND (21 G/2)

The Letang limestone deposit, located on the Letang Peninsula, about 8 km south of the town of St. George, is accessible by the Trans-Canada Highway, Highway 772, and a paved secondary road to the Bay of Fundy coast.

The Frye Island deposit is located near the southern end of a small island less than 1.5 km west of the Letang Peninsula. A narrow band of limestone and dolomite extends across the island from Birch Cove to Charlie Cove. The northern end of the deposit is about 1.5 km southwest of the Letang wharf, and the southern end about 2.4 km from the Village of Back Bay. The deposit is accessible only by water.

Geology: The general geology of the Letang-Frye Island limestone deposits has been presented by Uglow (1925), Goudge (1934), and more recently by Alcock and Perry (1960), Hamilton (1965), and Lee (1967). According to Hamilton (1965), the rocks in the region consist of northeast-trending, steeply dipping, felsic to mafic volcanic flows and tuffs associated with minor interbedded sedimentary rocks of Silurian age (Fig. 5-2). These rocks are cut by intermediate and mafic dykes of Paleozoic and possibly Triassic age. The volcanic rocks are generally unaltered but, in places, are sheared to chloritic or talcose schists. They range from grey to green in colour, are fine- to coarse-grained, and are locally vesicular and porphyritic. The sedimentary component of the sequence, consisting of interbedded sandstone, siltstone, shale, conglomerate, and limestone/dolomite, is quantitatively much less important than the volcanics.

Calcareous shale and limestone form an important part of the sedimentary rock assemblage in the area, occupying the core of a northeast-trending syncline at the southern end of the Letang Peninsula. These rocks can be traced to Frye Island where they form a narrow belt 120 to 150 m wide, striking southwest across the island, and dipping steeply to the north.

The Letang-Frye Island area rocks are included within a group of rocks referred to as the Mascarene Series. The resemblance of these rocks to lithologically similar fossiliferous strata nearby at Back Bay suggests a Middle Silurian age (Alcock and Perry 1960; Cumming 1962; Hamilton 1965).

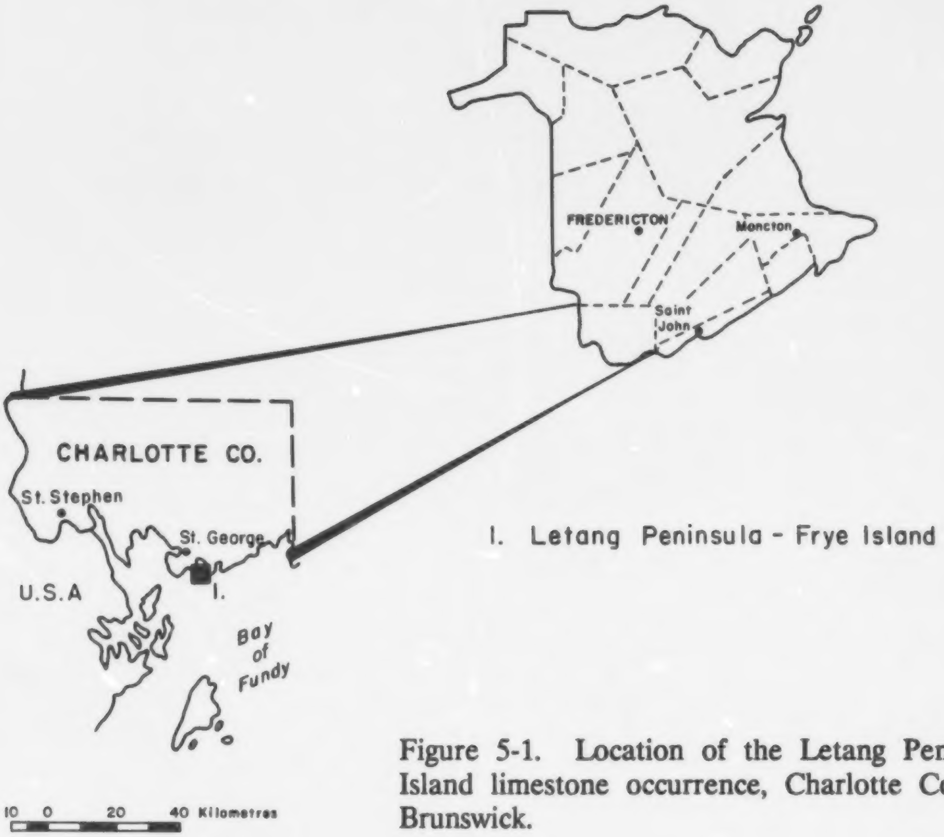

FREDERICTON
Moncton
Saint John
CHARLOTTE CO.
St. Stephen
St. George
U.S.A
1.
Bay of Fundy
10 0 20 40 Kilometres
1. Letang Peninsula - Frye Island

Figure 5-1. Location of the Letang Peninsula-Frye Island limestone occurrence, Charlotte County, New Brunswick.

The carbonates and associated calcareous sandstones and shales at Letang comprise a sequence about 450 m thick (Lee 1967). At the base of the sequence is a dark grey pebble conglomerate about 1 m thick. The conglomerate is overlain by dark grey to very light grey, fine-grained sandstone and shale approximately 60 m thick. These rocks are, in turn, overlain by calcareous argillites that grade upward into limestone.

Siliceous dolomite occurs locally as a lenticular band up to 10 m thick, near the base of the limestone and argillaceous limestone exposed on the southern flank of the syncline. The dolomite, highly fragmented, has a sugary texture and is of poor quality, containing up to 50% detrital quartz (Lee 1967). A zone of marble about 60 m wide marks the contact between overlying limestone and the siliceous dolomite. The marble is white to mottled grey, and is interbedded and intercalated with argillaceous limestone. It exhibits a well-developed fracture cleavage, causing it to break into sheets of 0.5 to 1 cm thick.

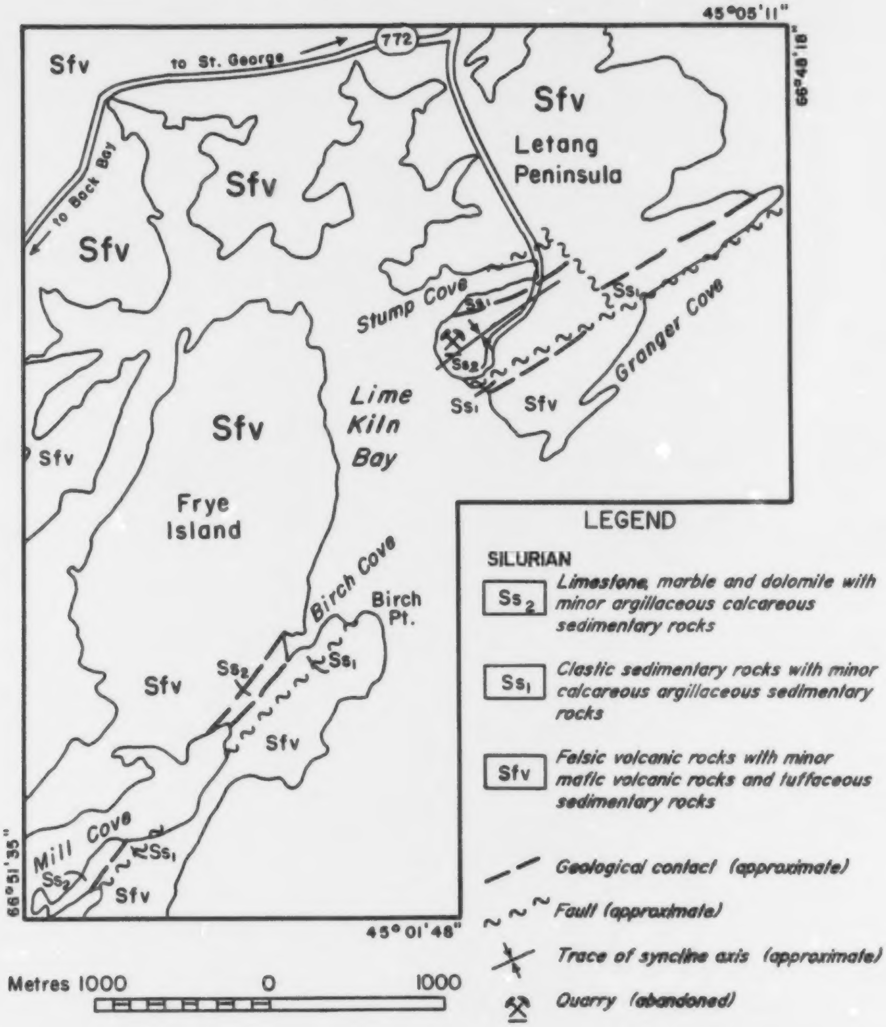

45°05'11"
66°48'18"
Sfv
to St. George
772
to Back Bay
Sfv
Sfv
Sfv
Letang
Peninsula
Stump Cove
Ss₁
Ss₂
Ss₁
Ss₁
Granger Cove
Sfv
Lime
Kiln
Bay
Sfv
Sfv
Frye
Island
Birch Cove
Birch
Pt.
Ss₂
Ss₁
Sfv
Sfv
Mill Cove
Ss₂
Ss₁
Sfv
66°51'35"
45°01'48"
Metres 1000
0
1000
LEGEND
SILURIAN
Ss₂
Limestone, marble and dolomite with minor argillaceous calcareous sedimentary rocks
Ss₁
Clastic sedimentary rocks with minor calcareous argillaceous sedimentary rocks
Sfv
Felsic volcanic rocks with minor mafic volcanic rocks and tuffaceous sedimentary rocks
Geological contact (approximate)
Fault (approximate)
Trace of syncline axis (approximate)
Quarry (abandoned)

Figure 5-2. Geology of the Letang Peninsula-Frye Island limestone deposits, Charlotte County, New Brunswick. For details see Plate 89-252.

The overlying limestone is medium light grey to light bluish grey and displays a medium light grey weathered surface. It is a very fine grained, shaly to flaggy rock that, in places, contains thin films and intercalations of argillaceous limestone and light grey to cream coloured dolomite. Lenses of grey sandstone and shale up to 10 m thick also occur within the limestone unit. Minor amounts of galena, barite, fluorite, and serpentine are also associated with the limestone.

Exploration and Development: The occurrence of limestone in the Letang-Frye Island area has been known since the early nineteenth century (Gesner 1839). Bailey (1864) and Feuctwanger (1866) reported quarry operations were underway in 1863. These early attempts at quarrying were apparently centred on the western part of the Letang Penisula. Between the late nineteenth and early twentieth century, the St. George Lime Company produced lime from the deposit, for export to the New England States. In 1927, a local St. George resident produced 400 tonnes of stone from the deposit, sending it to the Nashwaak Pulp and Paper Company in Saint John to test its suitability in the paper manufacturing industry. Apparently the material was found unsatisfactory for one reason or another and little interest was shown in the deposit until the mid-1950's.

In 1956, Stratmat Limited carried out a detailed assessment of the deposit. This included geological mapping, sampling, and diamond drilling to determine the stone's suitability as a component in the metallurgical treatment of manganese ores. Stratmat drilled two holes totalling 328 m of core. The company, not satisified with the results, was reluctant to proceed with a further evaluation of the property.

According to Hamilton (1965), as many as eight small quarries may have operated at one time or another in the Letang-Frye Island area. Most of these excavations were shelf-type workings generally less than 3 m deep. The location and surface configuration of these excavations were apparently controlled by the strike of limestone beds, their calcium carbonate content, and the disposition of contaminating mafic dykes that cut the deposit at various locations. One of the largest quarries, measuring about 215 m in length and 21 m in width, is located near the coast, northwest of the Letang wharf.

Hamilton (1965) estimated the Letang limestone deposit to extend over an area of about 20 ha. Assuming that 50% of this area is underlain by stone of mineable grade to a depth of about 12 m, the deposit is estimated to contain in excess of 4 000 000 tonnes grading 53.8% CaO (unweighted average of all outcrops). Although such an estimate would seem encouraging, it should be noted that the unweighted average of limestone intersected in one of the Stratmat drillholes, yields a grade of only 42.1% CaO over a horizontal distance of about 145 m. This is probably a function of contamination from argillaceous limestone interbeds and intruded dyke rock material encountered in the hole.

What would seem to be one of the more favourable limestone-bearing zones in the area is exposed along the shore, 150 m north of the Letang wharf. This zone occurs as a wedge-shaped body with a maximum width of about 65 m and a strike length of about

180 m. It is estimated to contain in excess of 150 000 tonnes, with an average grade greater than 53% CaO.

Due to a general lack of outcrop and reliable technical information, reserve and grade estimates have not been attempted for the limestone deposit on Frye Island.

Resource Evaluation: At first glance, the Letang limestone deposit would appear suitably situated for potential development. The deposit is accessible by road and water, and lies proximal to major transportation routes. It is at least 22 m above sea level over its entire strike length. Overburden thickness is expected to be generally less than a metre. Despite these favourable development conditions, proven limestone reserves of acceptable grade for most industrial applications is limited. However, it must be pointed out that the reserve estimates are based on limited exploration including only two drill holes located less than 130 m apart.

The presence of nearby habitation is also perceived to be an additional obstacle to development regardless of the quality and size of the deposit.

CHAPTER 6. CRITERIA FOR ASSESSING THE DEVELOPMENT POTENTIAL OF ORDOVICIAN-SILURIAN LIMESTONE RESOURCES IN NEW BRUNSWICK

Ordovician and Silurian limestone deposits identified during the course of this investigation have been evaluated and rated according to several parameters considered useful in the assessment of development potential. These include:

1. Formation to which the limestone belongs (some formations are statistically better sources of limestone than others, a result of favourable depositional environments and structural setting, etc.);
2. Grade ranges (% CaO);
3. Grade continuity;
4. Estimated recoverable reserves;
5. Observed maximum and minimum thickness;
6. Estimated average overburden thickness;
7. Dip range (structural complexity, i.e., folds, faults, etc.);
8. Deposit access;
9. Ecologic concerns:
   a. Location with respect to five or more dwellings;
   b. Location with respect to waterways, swamps, etc.;
10. Quarry opportunities (topographic setting); and
11. Level or degree of exploration/development activity.

The importance of these parameters regarding the eventual development of each deposit has been assessed objectively through the assignment of numerical ratings, based on a scale of one to five. Parameters interpreted as development deterrants have been assigned low rating values (i.e., 1 or 2), whereas parameters perceived to have a more positive influence on eventual development are identified by higher rating values (i.e., 4 or 5). Table 6-1 provides an explanation of the various rating values assigned to each parameter. More detailed information concerning parameter ratings of individual deposits appear in Appendix 1. Rating values have been totalled to establish an overall development priority for each deposit. Although those deposits with the highest totals may at first appear to have the best development potential, individual parameter ratings should be carefully considered in the evaluation process. To illustrate a potential inconsistency in the rating scheme, a deposit may achieve a good overall rating score but its grade range may not meet specified requirements for the intended end use.

Cumulative priority ratings for each deposit are shown in the stacked histograms of Figure 6-1. Assigned ratings are intended only as a guide and are not to be construed as the definitive endorsement or elimination of any deposit.

Table 6-1. Explanation of Development Parameters and Priority Rating Scheme for Selected Ordovician-Silurian Limestone Deposits in New Brunswick.

Development Parameters	Rating Scheme (Parameter Modifiers) Point Assignment				
	1	2	3	4	5
1. Formation/Group	Tetagouche Hartin	Matapedia Carys Mills Siegas (Craig Brook)	Limestone Point La Vieille (Belle slate) Smyrna Mills	Petit Rocher	-
2. Grade range (CaO%)	40.0	40.0-45.0	45.0-50.0	50.0-53.0	>53.0
3. Grade continuity	Poor (extr.var.)	Poor to Moderate	Moderate (var.-constant)	Moderate to Good	Good (constant)
4. Estimated reserves (million tonnes)	Very Limited (<1)	Limited (1-3)	Large (3-10)	Very Large (10-20)	Extensive (>20)
5. Observed maximum thickness (m)	1-3	3-10	10-15	15-20	>20
6. Estimated average overburden (m)	>8	6-8	4-6	2-4	<2
7. Dip ranges (deg.)	<45	34-45	25-35	15-25	0-15
8. Deposit access*	Very poor	Poor	Moderate	Good	Excellent
9. Ecologic					
A. Location, main part of deposit with respect to 5 or more dwellings (km)	Proximal <1/2	Proximal/ Distant 1/2-1	Distant 1-2	Distant/ Remote 2-3	Remote >3
B. Location, main part of deposit with respect to waterways, swamps (km)	Proximal <1/2	Proximal/ Distant 1/2-1	Distant/ Remote 1/2-1	Distant/ Remote 1-2	Remote >2
10. Main topographic setting**	Very Poor	Poor	Good	Very Good	Excellent
11. Level of exploration/development***	Very Low	Low	Moderate	High	Very High

More detailed information on the ratings for designated parameters.

*
1. Several kilometres of new roads required over rough, forested terrain.
2. 1-2 km of new road required over rough, forested terrain.
3. Less than 1 km of new road required over rough, forested terrain.
4. Upgrading of existing road or 1 to 2 km of new road required over open fields, pastures, or lightly forested areas.
5. Within 0.5 km of a main road.

**
1. Very narrow quarry width and/or low-lying area with poor drainage.
2. Narrow quarry width exposed along very steep to cliff-like hillside, or adjacent a major waterway.
3. Narrow quarry width exposed along gently sloping to moderately steep hillside.
4. Reasonable quarry widths exposed along a gently sloping to moderately steep hillside.
5. Reasonable quarry width occurring near the crest of a hill. Excellent drainage.

***
1. None to only a few samples analyzed.
2. Several samples analyzed. No drill hole data available.
3. Several samples analyzed with limited drill hole data available.
4. Numerous samples analyzed and data available from several drill holes.
5. Numerous samples analyzed and data available from many drill holes. Quarry development in some cases.

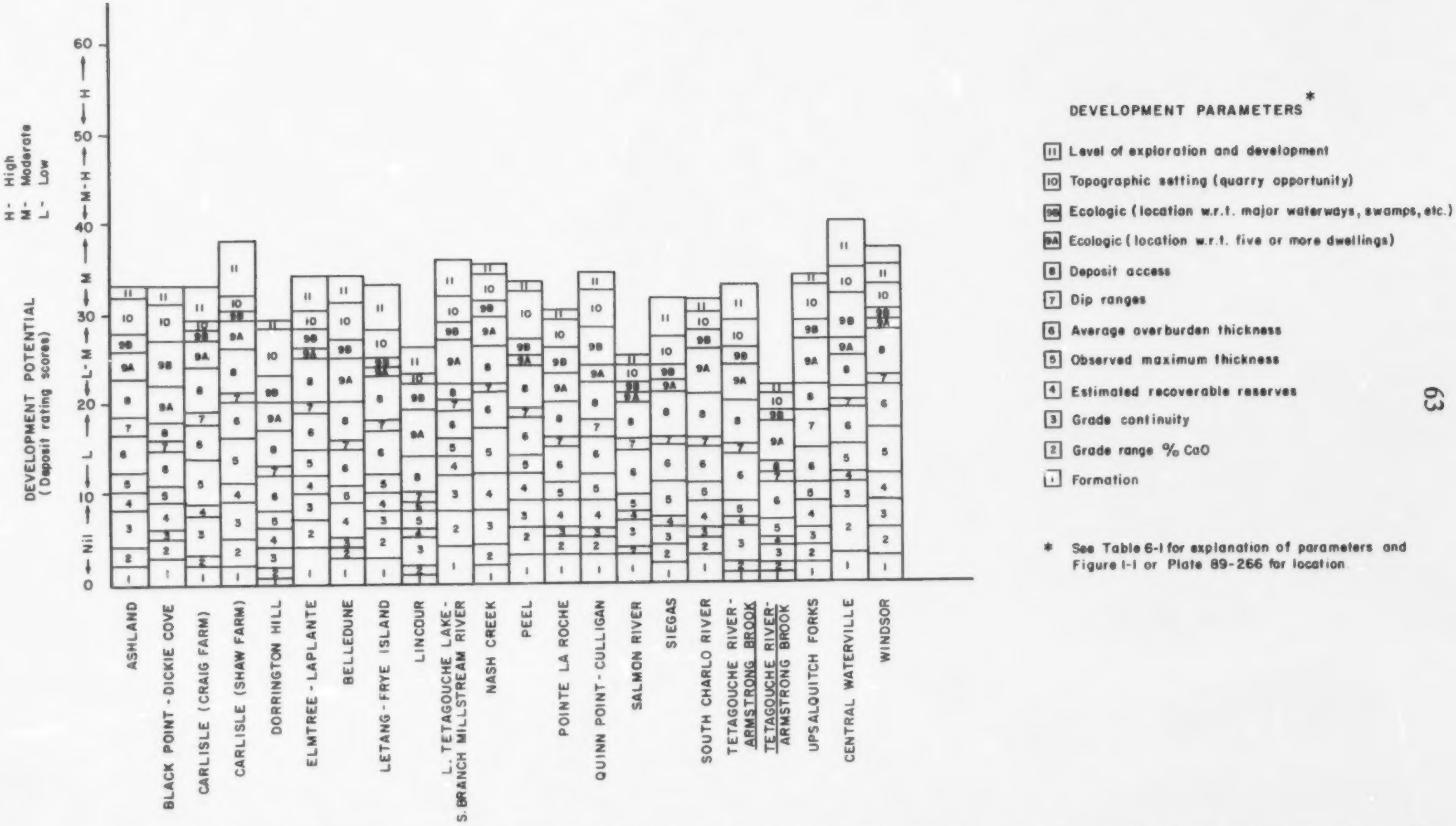
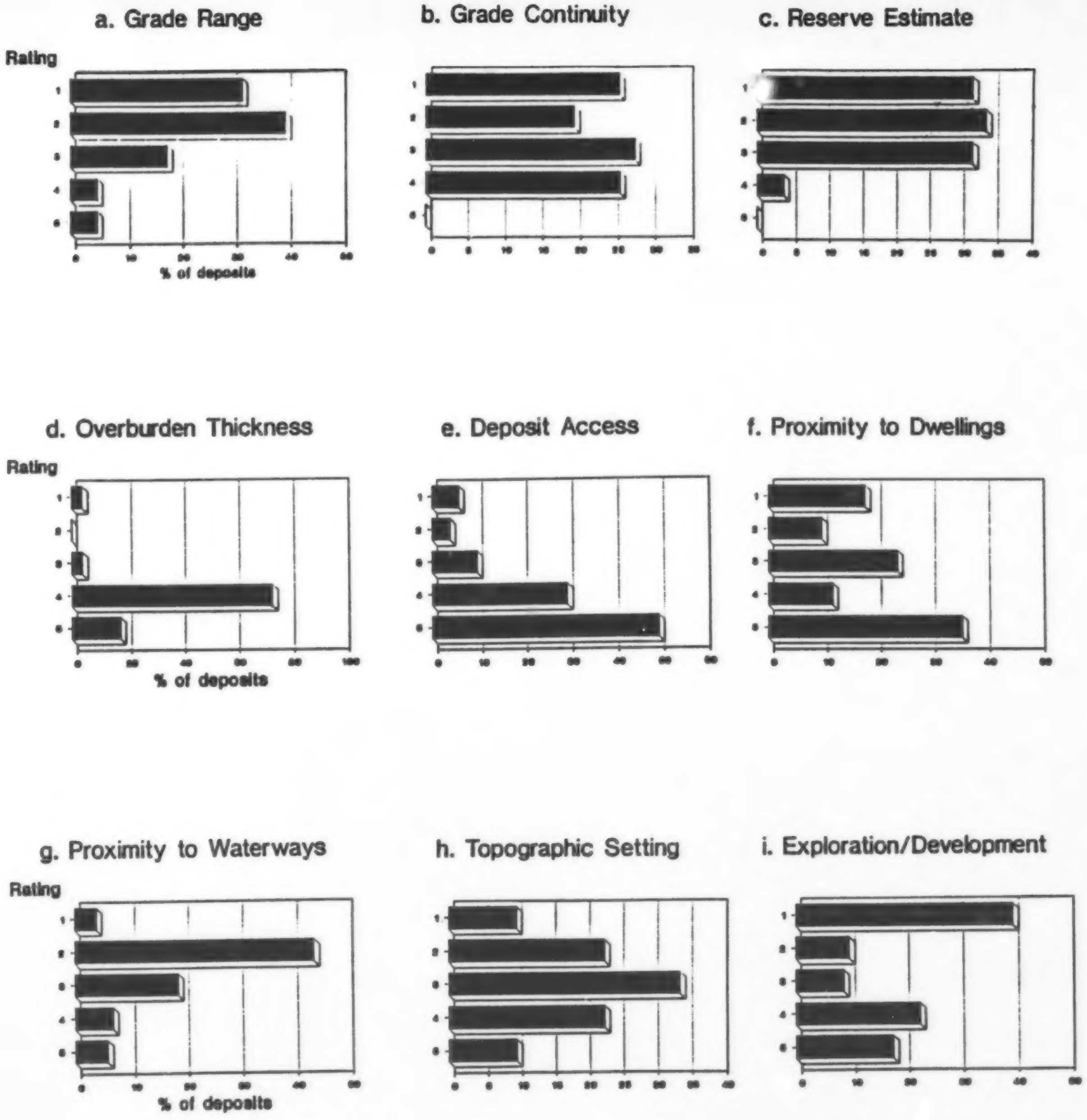


Figure 6-1. Summary of development priorities for various Ordovician-Silurian limestone deposits in New Brunswick. See plates (listed in Table of Contents) for details on individual deposits.

Twenty-two Ordovician-Silurian limestone deposits have been evaluated with respect to development potential. The following generalizations have emerged and are graphically presented in Figure 6-2:

1. About 80% of the deposits failed to achieve a grade exceeding 45 to 50% Ca0 (Fig. 6-2a). Despite their apparent poor quality, grade continuity in several are anticipated to be fairly consistent (Fig. 6-2b). Locally, Silurian limestones tend to be of superior quality compared to their Ordovician counterparts. However, the regional distribution of such deposits is often sporadic, resulting in deposits of rather limited extent.
2. Recoverable limestone reserve estimates for the majority of the deposits seldom exceed 10 million tonnes. About 65% probably contain reserves in the 3 to 5 million tonne range or less (Fig. 6-2c).
3. Overburden cover in the vicinity of most deposits is estimated at 2 to 4 m (Fig. 6-2d).
4. Steeply dipping strata (greater than 45°) distributed in narrow bands is a typical structural feature of many deposits.
5. For the most part, deposits are reasonably accessible, requiring minimal new road construction or upgrading of existing roads (Fig. 6-2e).
6. The potential for land-use conflicts with adjacent settlements is anticipated to be minimal for up to 60% of the deposits investigated. These would be situated 1 to 2 km from the nearest community consisting of five or more dwellings (Fig. 6-2f). Almost 70% of the deposits are located within 1 km of a waterway or swampy terrain (Fig.6-2g).
7. Two thirds of the deposits are either completely or partly situated on steeply to moderately sloping hillsides. Apart from other factors, such a setting, could be considered favourable for a quarry site (Fig. 6-2h).
8. Less than half the deposits have a record of past exploration or development (Fig. 6-2i).
9. Mineral rights* encompassing entire deposits or portions thereof are held as claims or mining leases for about 60% of those investigated.

* At the time of writing (1989)



number of deposits = 22

Figure 6-2. Cumulative deposit ratings for selected development parameters: New Brunswick Ordovician-Silurian limestone deposits.

CHAPTER 7. CONCLUSIONS

Ordovician and Silurian rocks are widely distributed throughout New Brunswick, underlying nearly 20% of the Province. Although limestone and related calcareous rocks are well represented in both systems, rarely do they attain a grade and extent where they could be commercially developed at the present time. Most of the more notable deposits occur in northern and northwestern New Brunswick. Smaller deposits are found in the west-central and southwestern parts of the Province.

Ordovician-Silurian limestones can broadly be categorized into four groups, each separated areally from each other, and each characterized by a particular lithologic assemblage. The first group occurs in the Baie des Chaleurs area where limestone-bearing rocks form an integral part of the Ordovician-Silurian stratigraphy of the region. The second group, located primarily in the northwestern part of the Province, is mostly associated with extensive Upper Ordovician-Silurian argillites belonging to the Carys Mills (Matapedia Group) and Siegas formations. A third group is situated in west-central New Brunswick, near Woodstock. Most limestone deposits in this area are largely associated with grey calcareous sandstones and siltstones of the Silurian age, Smyrna Mills Formation. A few Ordovician inliers, comprising argillaceous to crystalline limestone and referred to as the Craig Brook Limestone and the Belle Lake Slate, occur locally throughout the region. A slightly metamorphosed Silurian limestone belonging to the Hartin Formation is found at Dorrington Hill. The fourth group, located in the southwestern part of the Province, is associated with rocks of the Silurian age Mascarene Series. The sequence is characterized by a preponderance of volcanic rocks with minor sedimentary rocks that include limestone.

BAIE DES CHALEURS (Northern New Brunswick)

Notable Ordovician limestone deposits are not widespread in the Baie des Chaleurs area. A few occurrences southeast of Dalhousie are represented by thin, interbedded, argillaceous limestones and mudstones of the Matapedia Group, while other occurrences west of Bathurst are associated with an intensely deformed belt of Cambro-Ordovician volcanic and sedimentary rocks belonging to the Tetagouche Group. Limestone deposits in Tetagouche rocks are generally found interbedded with varying amounts of calcareous slate. Most Ordovician limestone deposits in the region are relatively impure.

Better quality limestone deposits of the Baies des Chaleurs region are associated with Lower to Middle Silurian strata. These rocks are found scattered along the coast between Campbellton and Beresford and in a few isolated inland exposures. Limestone-bearing rocks are stratigraphically distributed in three formations: the Limestone Point, the La Vieille, and Petit Rocher formations.

The Limestone Point Formation consists of a sequence of calcareous sandstone, frequently interbedded with irregular lenses of limestone. Although massive laminated, calcareous siltstones dominate the lithology of the La Vieille Formation, thick- to medium-bedded, highly fossiliferous, nodular limestone and silty limestone occur locally. A third assemblage of Silurian limestone in the area is represented by the Petit Rocher Formation. It comprises red, green, and grey calcareous shale and siltstone, and minor sandstone and contains remnants of Late Silurian carbonate reefs. These reefs and associated sediments are confined to a regional syncline, extending from Petit Rocher, 70 km to the southwest. Reefal limestones occur sporadically in outcrop and in small quarries along the strike length of this structure. Among the best exposures are those north of Upsalquitch Lake adjacent to the "Road to Resources"; near the eastern outlet of Lower Tetagouche Lake; west of Sormany; and at LaPlante and Elmtree. These deposits probably represent large allochthonous blocks of reefal material that have come to rest on, and are embedded in, basinal calcareous clastics (turbidites). They are significant in that they are among the highest quality limestone deposits found in Silurian strata in New Brunswick, and provide feed stock for northern New Brunswick's only limestone production facility, at Elmtree.

NORTHWESTERN NEW BRUNSWICK

Limestone resources of northwestern New Brunswick are, for the most part, associated with the sequence of Upper Ordovician to Lower Silurian strata, collectively referred to as the Matapedia Group. These rocks are spread over a considerable area, extending in a 50 km wide zone southwest of Campbellton to Grand Falls and then south to Woodstock, straddling the Canada-United States border. Similar to the Matapedia rocks in the Baie des Chaleurs region, their most salient feature is a monotonous lithology, in which hundreds of metres of grey, calcareous argillite, grey to black argillaceous limestone, and grey, crystalline limestone are thinly and regularly interbedded with one another. Typically, the thin, interbedded nature of the limestone and associated argillaceous material generally results in overall low-grade deposits compared to other limestone occurrences throughout the Province. Even though higher grade deposits may occur locally, most yield low MgO values accompanied by CaO values seldom exceeding 35%. It is also important to note that these rocks have been folded and faulted to varying degrees which further complicate resource development.

WEST-CENTRAL NEW BRUNSWICK

Both Ordovician and Silurian limestones occur in relatively small scattered deposits in west-central New Brunswick. With few exceptions, most known deposits are situated northeast of Woodstock, within a 7 km radius of each other. Most tend to be associated with grey, calcareous sandstones and siltstone of the Silurian age Smyrna Mills Formation. A few inliers of Ordovician (i.e., Craig Brook Limestone) argillite and associated argillaceous to siliceous limestone occur locally. East and south of Woodstock, limestone occurrences are represented by an Ordovician inlier at Central Waterville and a slightly metamorphosed deposit of Silurian age at Dorrington Hill.

Generally, limestone-bearing strata in this part of the Province is characterized by a relatively complex structural history. Intense folding and thrust faulting are reflected in moderate to steep dips and boudinage, resulting in somewhat small, isolated deposits of limited lateral and vertical extent. Most are typically low in MgO and exhibit a wide variation in CaO content (35-55%).

SOUTHWESTERN NEW BRUNSWICK

Significant Silurian limestone occurs on the coast of the Bay of Fundy near Letang, in the southwestern part of the Province. These rocks comprise part of the Mascarene Series, a sequence of felsic to mafic volcanics and tuffs with minor interbedded clastics including limestone and dolomite. Although, at first glance, reserves of high-calcium stone appear fairly extensive at Letang, contamination from argillaceous interbeds and intruded dyke rock would probably require a measure of selective quarrying to maintain consistent and acceptable grade levels.

In general, Ordovician-Silurian limestone resources of New Brunswick are characterized by deposits of poor to low quality stone. Although higher quality deposits are known to exist locally, particularly in Silurian rocks of reefal origin, their distribution is somewhat erratic and reserves at specific sites are usually limited to a few million tonnes. The most favourable region to explore for such deposits flanks the northern boundary of the Miramichi Anticlinorium, along a narrow belt of Silurian-Devonian strata extending southwest from Petit Rocher on the Baie des Chaleurs to the Becaguimec River area, near Woodstock.

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APPENDIX 1.

PRIORITY RATINGS OF PARAMETERS PERTAINING TO THE DEVELOPMENT POTENTIAL OF SELECTED ORDOVICIAN-SILURIAN LIMESTONE DEPOSITS[1] IN NEW BRUNSWICK

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[1] deposits/occurrences are listed alphabetically

Ordovician and Silurian limestone deposits identified and evaluated during the course of this investigation have been classified and rated according to several parameters considered useful in the assessment of development potential. They are:

1. Formation to which the limestone belongs (some formations are statistically better sources of limestone than others, a result of favourable depositional environments, and structural setting, etc.);
2. Grade ranges (% CaO);
3. Grade continuity;
4. Estimated reserves;
5. Observed maximum and minimum thickness;
6. Estimated average overburden thickness;
7. Dip range (structural complexity, i.e., folds, faults, etc.);
8. Deposit access;
9. Ecologic concerns:
   a. Location with respect to five or more dwellings;
   b. Location with respect to waterways, swamps, etc.;
10. Quarry opportunities (topographic setting); and
11. Level or degree of exploration/development activity.

The importance of these parameters regarding the eventual development of each deposit has been assessed objectively through the assignment of numerical ratings, on a scale of one to five. Parameters interpreted as deterrants to potential development have been assigned low rating values (i.e., 1 or 2), whereas parameters that may have more positive influence on eventual development are identified by higher rating values (i.e., 4 or 5). An explanatory table for the various rating values appears adjacent to each detailed tabulation of parameter ratings for individual deposits. Rating values have been totalled to establish an overall development priority for each deposit. Although those deposits with the highest totals may at first appear to have the best development potential, individual parameter ratings should be carefully considered in the complete evaluation process. To illustrate potential inconsistences in the rating scheme, a deposit may achieve a high overall rating score, however, its grade range may not meet specified requirements for the intended end use. Assigned ratings are intended only as a guide and should not be construed as a definitive endorsement or elimination of any deposit.

Development Parameters Scheme

Development Parameters	Rating Scheme (Parameter Modifiers) Point Assignment				
	1	2	3	4	5
1. Formation/Group	Tetagouche Hartin	Matapedia Carys Mills Siegas (Craig Brook)	Limestone Point La Vieille (Belle slate) Smyrna Mills	Petit Rocher	-
2. Grade range (CaO%)	40.0	40.0-45.0	45.0-50.0	50.0-53.0	>53.0
3. Grade continuity	Poor (extr.var.)	Poor to Moderate	Moderate (var.-constant)	Moderate to Good	Good (constant)
4. Estimated reserves (million tonnes)	Very Limited (<1)	Limited (1-3)	Large (3-10)	Very Large (10-20)	Extensive (>20)
5. Observed maximum thickness (m)	1-3	3-10	10-15	15-20	>20
6. Estimated average overburden (m)	>8	6-8	4-6	2-4	<2
7. Dip ranges (deg.)	<45	34-45	25-35	15-25	0-15
8. Deposit access*	Very poor	Poor	Moderate	Good	Excellent
9. Ecologic					
A. Location, main part of deposit with respect to 5 or more dwellings (km)	Proximal <1/2	Proximal/ Distant 1/2-1	Distant 1-2	Distant/ Remote 2-3	Remote >3
B. Location, main part of deposit with respect to waterways, swamps (km)	Proximal <1/2	Proximal/ Distant 1/2-1	Distant/ Remote 1/2-1	Distant/ Remote 1-2	Remote >2
10. Main topographic setting**	Very Poor	Poor	Good	Very Good	Excellent
11. Level of exploration/development***	Very Low	Low	Moderate	High	Very High

More detailed information on the ratings for designated parameters.

*

1. Several kilometres of new roads required over rough, forested terrain.
2. 1-2 km of new road required over rough, forested terrain.
3. Less than 1 km of new road required over rough, forested terrain.
4. Upgrading of existing road or 1 to 2 km of new road required over open fields, pastures, or lightly forested areas.
5. Within 0.5 km of a main road.

**

1. Very narrow quarry width and/or low-lying area with poor drainage.
2. Narrow quarry width exposed along very steep to cliff-like hillside, or adjacent a major waterway.
3. Narrow quarry width exposed along gently sloping to moderately steep hillside.
4. Reasonable quarry widths exposed along a gently sloping to moderately steep hillside.
5. Reasonable quarry width occurring near the crest of a hill. Excellent drainage.

***

1. None to only a few samples analyzed.
2. Several samples analyzed. No drill hole data available.
3. Several samples analyzed with limited drill hole data available.
4. Numerous samples analyzed and data available from several drill holes.
5. Numerous samples analyzed and data available from many drill holes. Quarry development in some cases.

DEVELOPMENT PARAMETERS FOR ORDOVICIAN-SILURIAN LIMESTONE DEPOSITS IN NEW BRUNSWICK

DEPOSIT NAME: Ashland

N.T.S.: 21 J/6

	DEVELOPMENT PARAMETERS	**RATING**				
		1	**2**	**3**	**4**	**5**
1.	Formation		X			
2.	Grade range		X			
3.	Grade continuity				X	
4.	Estimated reserves		X *			
5.	Observed max./min. thickness		X *			
6.	Estimated overburden				X	
7.	Dip ranges		X			
8.	Deposit access				X	
9A.	Ecologic location with respect to dwellings			X		
9B.	Ecologic location with respect to waterways		X			
10.	Topographic setting				X	
11.	Level of exploration/ development		X			

DEPOSIT PRIORITY RATING (60 max.): $32^{(2)**}$

For a more detailed explanation concerning priority ratings see Development Parameters Scheme on adjacent page.

* low level of confidence.
** (2) total number of low confidence parameters.

Development Parameters Scheme

Development Parameters	Rating Scheme (Parameter Modifiers) Point Assignment				
	1	2	3	4	5
1. Formation/Group	Tetagouche Hartin	Matapedia Carys Mills Siegas (Craig Brook)	Limestone Point La Vieille (Belle slate) Smyrna Mills	Petit Rocher	-
2. Grade range (CaO%)	40.0	40.0-45.0	45.0-50.0	50.0-53.0	>53.0
3. Grade continuity	Poor (extr.var.)	Poor to Moderate	Moderate (var.-constant)	Moderate to Good	Good (constant)
4. Estimated reserves (million tonnes)	Very Limited (<1)	Limited (1-3)	Large (3-10)	Very Large (10-20)	Extensive (>20)
5. Observed maximum thickness (m)	1-3	3-10	10-15	15-20	>20
6. Estimated average overburden (m)	>8	6-8	4-6	2-4	<2
7. Dip ranges (deg.)	<45	34-45	25-35	15-25	0-15
8. Deposit access*	Very poor	Poor	Moderate	Good	Excellent
9. Ecologic					
A. Location, main part of deposit with respect to 5 or more dwellings (km)	Proximal <1/2	Proximal/ Distant 1/2-1	Distant 1-2	Distant/ Remote 2-3	Remote >3
B. Location, main part of deposit with respect to waterways, swamps (km)	Proximal <1/2	Proximal/ Distant 1/2-1	Distant/ Remote 1/2-1	Distant/ Remote 1-2	Remote >2
10. Main topographic setting**	Very Poor	Poor	Good	Very Good	Excellent
11. Level of exploration/development***	Very Low	Low	Moderate	High	Very High

More detailed information on the ratings for designated parameters.

*
1. Several kilometres of new roads required over rough, forested terrain.
2. 1-2 km of new road required over rough, forested terrain.
3. Less than 1 km of new road required over rough, forested terrain.
4. Upgrading of existing road or 1 to 2 km of new road required over open fields, pastures, or lightly forested areas.
5. Within 0.5 km of a main road.

**
1. Very narrow quarry width and/or low-lying area with poor drainage.
2. Narrow quarry width exposed along very steep to cliff-like hillside, or adjacent a major waterway.
3. Narrow quarry width exposed along gently sloping to moderately steep hillside.
4. Reasonable quarry widths exposed along a gently sloping to moderately steep hillside.
5. Reasonable quarry width occurring near the crest of a hill. Excellent drainage.

***
1. None to only a few samples analyzed.
2. Several samples analyzed. No drill hole data available.
3. Several samples analyzed with limited drill hole data available.
4. Numerous samples analyzed and data available from several drill holes.
5. Numerous samples analyzed and data available from many drill holes. Quarry development in some cases.

DEVELOPMENT PARAMETERS FOR ORDOVICIAN-SILURIAN LIMESTONE DEPOSITS IN NEW BRUNSWICK

DEPOSIT NAME: Black Point-Dickie Cove

N.T.S.: 21 O/16

DEVELOPMENT PARAMETERS		RATING				
		1	2	3	4	5
1.	Formation			X		
2.	Grade range		X			
3.	Grade continuity	X				
4.	Estimated reserves				X*	
5.	Observed max./min. thickness		X			
6.	Estimated overburden				X	
7.	Dip ranges	X				
8.	Deposit access		X			
9A.	Ecologic location with respect to dwellings				X	
9B.	Ecologic location with respect to waterways					X
10.	Topographic setting				X	
11.	Level of exploration/ development	X				

DEPOSIT PRIORITY RATING (60 max.): $32^{(1)**}$

For a more detailed explanation concerning priority ratings see Development Parameters Scheme on adjacent page.

* low level of confidence.

** (1) total number of low confidence parameters.

Development Parameters Scheme

Development Parameters	Rating Scheme (Parameter Modifiers) Point Assignment				
	1	2	3	4	5
1. Formation/Group	Tetagouche Hartin	Matapedia Carys Mills Siegas (Craig Brook)	Limestone Point La Vieille (Belle slate) Smyrna Mills	Petit Rocher	-
2. Grade range (CaO%)	40.0	40.0-45.0	45.0-50.0	50.0-53.0	>53.0
3. Grade continuity	Poor (extr.var.)	Poor to Moderate	Moderate (var.-constant)	Moderate to Good	Good (constant)
4. Estimated reserves (million tonnes)	Very Limited (<1)	Limited (1-3)	Large (3-10)	Very Large (10-20)	Extensive (>20)
5. Observed maximum thickness (m)	1-3	3-10	10-15	15-20	>20
6. Estimated average overburden (m)	>8	6-8	4-6	2-4	<2
7. Dip ranges (deg.)	<45	34-45	25-35	15-25	0-15
8. Deposit access*	Very poor	Poor	Moderate	Good	Excellent
9. Ecologic					
A. Location, main part of deposit with respect to 5 or more dwellings (km)	Proximal <1/2	Proximal/ Distant 1/2-1	Distant 1-2	Distant/ Remote 2-3	Remote >3
B. Location, main part of deposit with respect to waterways, swamps (km)	Proximal <1/2	Proximal/ Distant 1/2-1	Distant/ Remote 1/2-1	Distant/ Remote 1-2	Remote >2
10. Main topographic setting**	Very Poor	Poor	Good	Very Good	Excellent
11. Level of exploration/development***	Very Low	Low	Moderate	High	Very High

More detailed information on the ratings for designated parameters.

*

1. Several kilometres of new roads required over rough, forested terrain.
2. 1-2 km of new road required over rough, forested terrain.
3. Less than 1 km of new road required over rough, forested terrain.
4. Upgrading of existing road or 1 to 2 km of new road required over open fields, pastures, or lightly forested areas.
5. Within 0.5 km of a main road.

**

1. Very narrow quarry width and/or low-lying area with poor drainage.
2. Narrow quarry width exposed along very steep to cliff-like hillside, or adjacent a major waterway.
3. Narrow quarry width exposed along gently sloping to moderately steep hillside.
4. Reasonable quarry widths exposed along a gently sloping to moderately steep hillside.
5. Reasonable quarry width occurring near the crest of a hill. Excellent drainage.

***

1. None to only a few samples analyzed.
2. Several samples analyzed. No drill hole data available.
3. Several samples analyzed with limited drill hole data available.
4. Numerous samples analyzed and data available from several drill holes.
5. Numerous samples analyzed and data available from many drill holes. Quarry development in some cases.

DEVELOPMENT PARAMETERS FOR ORDOVICIAN-SILURIAN LIMESTONE DEPOSITS IN NEW BRUNSWICK

DEPOSIT NAME: Carlisle (Craig Farm)

N.T.S.: 21 J/6

DEVELOPMENT PARAMETERS		RATING				
		1	2	3	4	5
1.	Formation		X			
2.	Grade range	X				
3.	Grade continuity				X	
4.	Estimated reserves	X				
5.	Observed max./min. thickness					X
6.	Estimated overburden				X	
7.	Dip ranges	X				
8.	Deposit access					X
9A.	Ecologic location with respect to dwellings			X		
9B.	Ecologic location with respect to waterways	X				
10.	Topographic setting	X				
11.	Level of exploration/ development					X

DEPOSIT PRIORITY RATING (60 max.): 33

For a more detailed explanation concerning priority ratings see Development Parameters Scheme on adjacent page.

Development Parameters Scheme

Development Parameters	Rating Scheme (Parameter Modifiers) Point Assignment				
	1	2	3	4	5
1. Formation/Group	Tetagouche Hartin	Matapedia Carys Mills Siegas (Craig Brook)	Limestone Point La Vieille (Belle slate) Smyrna Mills	Petit Rocher	-
2. Grade range (CaO%)	40.0	40.0-45.0	45.0-50.0	50.0-53.0	>53.0
3. Grade continuity	Poor (extr.var.)	Poor to Moderate	Moderate (var.-constant)	Moderate to Good	Good (constant)
4. Estimated reserves (million tonnes)	Very Limited (<1)	Limited (1-3)	Large (3-10)	Very Large (10-20)	Extensive (>20)
5. Observed maximum thickness (m)	1-3	3-10	10-15	15-20	>20
6. Estimated average overburden (m)	>8	6-8	4-6	2-4	<2
7. Dip ranges (deg.)	<45	34-45	25-35	15-25	0-15
8. Deposit access*	Very poor	Poor	Moderate	Good	Excellent
9. Ecologic					
A. Location, main part of deposit with respect to 5 or more dwellings (km)	Proximal <1/2	Proximal/ Distant 1/2-1	Distant 1-2	Distant/ Remote 2-3	Remote >3
B. Location, main part of deposit with respect to waterways, swamps (km)	Proximal <1/2	Proximal/ Distant 1/2-1	Distant/ Remote 1/2-1	Distant/ Remote 1-2	Remote >2
10. Main topographic setting**	Very Poor	Poor	Good	Very Good	Excellent
11. Level of exploration/development***	Very Low	Low	Moderate	High	Very High

More detailed information on the ratings for designated parameters.

*

1. Several kilometres of new roads required over rough, forested terrain.
2. 1-2 km of new road required over rough, forested terrain.
3. Less than 1 km of new road required over rough, forested terrain.
4. Upgrading of existing road or 1 to 2 km of new road required over open fields, pastures, or lightly forested areas.
5. Within 0.5 km of a main road.

**

1. Very narrow quarry width and/or low-lying area with poor drainage.
2. Narrow quarry width exposed along very steep to cliff-like hillside, or adjacent a major waterway.
3. Narrow quarry width exposed along gently sloping to moderately steep hillside.
4. Reasonable quarry widths exposed along a gently sloping to moderately steep hillside.
5. Reasonable quarry width occurring near the crest of a hill. Excellent drainage.

***

1. None to only a few samples analyzed.
2. Several samples analyzed. No drill hole data available.
3. Several samples analyzed with limited drill hole data available.
4. Numerous samples analyzed and data available from several drill holes.
5. Numerous samples analyzed and data available from many drill holes. Quarry development in some cases.

DEVELOPMENT PARAMETERS FOR ORDOVICIAN-SILURIAN LIMESTONE DEPOSITS IN NEW BRUNSWICK

DEPOSIT NAME: Carlisle (Shaw Farm)

N.T.S.: 21 J/6

	DEVELOPMENT PARAMETERS	RATING 1	2	3	4	5
1.	Formation		X			
2.	Grade range			X		
3.	Grade continuity				X	
4.	Estimated reserves		X			
5.	Observed max./min. thickness					X
6.	Estimated overburden				X	
7.	Dip ranges	X				
8.	Deposit access					X
9A.	Ecologic location with respect to dwellings			X		
9B.	Ecologic location with respect to waterways	X				
10.	Topographic setting		X			
11.	Level of exploration/ development					X

DEPOSIT PRIORITY RATING (60 max.): 37

For a more detailed explanation concerning priority ratings see Development Parameters Scheme on adjacent page.

Development Parameters Scheme

Development Parameters	Rating Scheme (Parameter Modifiers) Point Assignment				
	1	2	3	4	5
1. Formation/Group	Tetagouche Hartin	Matapedia Carys Mills Siegas (Craig Brook)	Limestone Point La Vieille (Belle slate) Smyrna Mills	Petit Rocher	-
2. Grade range (CaO%)	40.0	40.0-45.0	45.0-50.0	50.0-53.0	>53.0
3. Grade continuity	Poor (extr.var.)	Poor to Moderate	Moderate (var.-constant)	Moderate to Good	Good (constant)
4. Estimated reserves (million tonnes)	Very Limited (<1)	Limited (1-3)	Large (3-10)	Very Large (10-20)	Extensive (>20)
5. Observed maximum thickness (m)	1-3	3-10	10-15	15-20	>20
6. Estimated average overburden (m)	>8	6-8	4-6	2-4	<2
7. Dip ranges (deg.)	<45	34-45	25-35	15-25	0-15
8. Deposit access*	Very poor	Poor	Moderate	Good	Excellent
9. Ecologic					
A. Location, main part of deposit with respect to 5 or more dwellings (km)	Proximal <1/2	Proximal/ Distant 1/2-1	Distant 1-2	Distant/ Remote 2-3	Remote >3
B. Location, main part of deposit with respect to waterways, swamps (km)	Proximal <1/2	Proximal/ Distant 1/2-1	Distant/ Remote 1/2-1	Distant/ Remote 1-2	Remote >2
10. Main topographic setting**	Very Poor	Poor	Good	Very Good	Excellent
11. Level of exploration/development***	Very Low	Low	Moderate	High	Very High

More detailed information on the ratings for designated parameters.

*
1. Several kilometres of new roads required over rough, forested terrain.
2. 1-2 km of new road required over rough, forested terrain.
3. Less than 1 km of new road required over rough, forested terrain.
4. Upgrading of existing road or 1 to 2 km of new road required over open fields, pastures, or lightly forested areas.
5. Within 0.5 km of a main road.

**
1. Very narrow quarry width and/or low-lying area with poor drainage.
2. Narrow quarry width exposed along very steep to cliff-like hillside, or adjacent a major waterway.
3. Narrow quarry width exposed along gently sloping to moderately steep hillside.
4. Reasonable quarry widths exposed along a gently sloping to moderately steep hillside.
5. Reasonable quarry width occurring near the crest of a hill. Excellent drainage.

***
1. None to only a few samples analyzed.
2. Several samples analyzed. No drill hole data available.
3. Several samples analyzed with limited drill hole data available.
4. Numerous samples analyzed and data available from several drill holes.
5. Numerous samples analyzed and data available from many drill holes. Quarry development in some cases.

DEVELOPMENT PARAMETERS FOR ORDOVICIAN-SILURIAN LIMESTONE DEPOSITS IN NEW BRUNSWICK

DEPOSIT NAME: Dorrington Hill

N.T.S.: 21 G/14

DEVELOPMENT PARAMETERS		RATING				
		1	2	3	4	5
1.	Formation	X				
2.	Grade range	X				
3.	Grade continuity		X *			
4.	Estimated reserves		X *			
5.	Observed max./min. thickness		X *			
6.	Estimated overburden				X	
7.	Dip ranges	X				
8.	Deposit access				X	
9A.	Ecologic location with respect to dwellings			X		
9B.	Ecologic location with respect to waterways			X		
10.	Topographic setting					X
11.	Level of exploration/ development	X				

DEPOSIT PRIORITY RATING (60 max.): 29(3)**

For a more detailed explanation concerning priority ratings see Development Parameters Scheme on adjacent page.

* low level of confidence.

** (3) total number of low confidence parameters.

Development Parameters Scheme

Development Parameters	Rating Scheme (Parameter Modifiers) Point Assignment				
	1	2	3	4	5
1. Formation/Group	Tetagouche Hartin	Matapedia Carys Mills Siegas (Craig Brook)	Limestone Point La Vieille (Belle slate) Smyrna Mills	Petit Rocher	-
2. Grade range (CaO%)	40.0	40.0-45.0	45.0-50.0	50.0-53.0	>53.0
3. Grade continuity	Poor (extr.var.)	Poor to Moderate	Moderate (var.-constant)	Moderate to Good	Good (constant)
4. Estimated reserves (million tonnes)	Very Limited (<1)	Limited (1-3)	Large (3-10)	Very Large (10-20)	Extensive (>20)
5. Observed maximum thickness (m)	1-3	3-10	10-15	15-20	>20
6. Estimated average overburden (m)	>8	6-8	4-6	2-4	<2
7. Dip ranges (deg.)	<45	34-45	25-35	15-25	0-15
8. Deposit access*	Very poor	Poor	Moderate	Good	Excellent
9. Ecologic					
A. Location, main part of deposit with respect to 5 or more dwellings (km)	Proximal <1/2	Proximal/ Distant 1/2-1	Distant 1-2	Distant/ Remote 2-3	Remote >3
B. Location, main part of deposit with respect to waterways, swamps (km)	Proximal <1/2	Proximal/ Distant 1/2-1	Distant/ Remote 1/2-1	Distant/ Remote 1-2	Remote >2
10. Main topographic setting**	Very Poor	Poor	Good	Very Good	Excellent
11. Level of exploration/development***	Very Low	Low	Moderate	High	Very High

More detailed information on the ratings for designated parameters.

*

1. Several kilometres of new roads required over rough, forested terrain.
2. 1-2 km of new road required over rough, forested terrain.
3. Less than 1 km of new road required over rough, forested terrain.
4. Upgrading of existing road or 1 to 2 km of new road required over open fields, pastures, or lightly forested areas.
5. Within 0.5 km of a main road.

**

1. Very narrow quarry width and/or low-lying area with poor drainage.
2. Narrow quarry width exposed along very steep to cliff-like hillside, or adjacent a major waterway.
3. Narrow quarry width exposed along gently sloping to moderately steep hillside.
4. Reasonable quarry widths exposed along a gently sloping to moderately steep hillside.
5. Reasonable quarry width occurring near the crest of a hill. Excellent drainage.

***

1. None to only a few samples analyzed.
2. Several samples analyzed. No drill hole data available.
3. Several samples analyzed with limited drill hole data available.
4. Numerous samples analyzed and data available from several drill holes.
5. Numerous samples analyzed and data available from many drill holes. Quarry development in some cases.

DEVELOPMENT PARAMETERS FOR ORDOVICIAN-SILURIAN LIMESTONE DEPOSITS IN NEW BRUNSWICK

DEPOSIT NAME: Elmtree-LaPlante

N.T.S.: 21 P/6

DEVELOPMENT PARAMETERS		**RATING**				
		1	**2**	**3**	**4**	**5**
1.	Formation				X	
2.	Grade range			X		
3.	Grade continuity			X		
4.	Estimated reserves		X			
5.	Observed max./min. thickness			X		
6.	Estimated overburden				X	
7.	Dip ranges	X				
8.	Deposit access					X
9A.	Ecologic location with respect to dwellings	X				
9B.	Ecologic location with respect to waterways		X			
10.	Topographic setting		X			
11.	Level of exploration/ development				X	

DEPOSIT PRIORITY RATING (60 max.): 34

For a more detailed explanation concerning priority ratings see Development Parameters Scheme on adjacent page.

Development Parameters Scheme

Development Parameters	Rating Scheme (Parameter Modifiers) Point Assignment				
	1	2	3	4	5
1. Formation/Group	Tetagouche Hartin	Matapedia Carys Mills Siegas (Craig Brook)	Limestone Point La Vieille (Belle slate) Smyrna Mills	Petit Rocher	-
2. Grade range (CaO%)	40.0	40.0-45.0	45.0-50.0	50.0-53.0	>53.0
3. Grade continuity	Poor (extr.var.)	Poor to Moderate	Moderate (var.-constant)	Moderate to Good	Good (constant)
4. Estimated reserves (million tonnes)	Very Limited (<1)	Limited (1-3)	Large (3-10)	Very Large (10-20)	Extensive (>20)
5. Observed maximum thickness (m)	1-3	3-10	10-15	15-20	>20
6. Estimated average overburden (m)	>8	6-8	4-6	2-4	<2
7. Dip ranges (deg.)	<45	34-45	25-35	15-25	0-15
8. Deposit access*	Very poor	Poor	Moderate	Good	Excellent
9. Ecologic					
A. Location, main part of deposit with respect to 5 or more dwellings (km)	Proximal <1/2	Proximal/ Distant 1/2-1	Distant 1-2	Distant/ Remote 2-3	Remote >3
B. Location, main part of deposit with respect to waterways, swamps (km)	Proximal <1/2	Proximal/ Distant 1/2-1	Distant/ Remote 1/2-1	Distant/ Remote 1-2	Remote >2
10. Main topographic setting**	Very Poor	Poor	Good	Very Good	Excellent
11. Level of exploration/development***	Very Low	Low	Moderate	High	Very High

More detailed information on the ratings for designated parameters.

*
1. Several kilometres of new roads required over rough, forested terrain.
2. 1-2 km of new road required over rough, forested terrain.
3. Less than 1 km of new road required over rough, forested terrain.
4. Upgrading of existing road or 1 to 2 km of new road required over open fields, pastures, or lightly forested areas.
5. Within 0.5 km of a main road.

**
1. Very narrow quarry width and/or low-lying area with poor drainage.
2. Narrow quarry width exposed along very steep to cliff-like hillside, or adjacent a major waterway.
3. Narrow quarry width exposed along gently sloping to moderately steep hillside.
4. Reasonable quarry widths exposed along a gently sloping to moderately steep hillside.
5. Reasonable quarry width occurring near the crest of a hill. Excellent drainage.

***
1. None to only a few samples analyzed.
2. Several samples analyzed. No drill hole data available.
3. Several samples analyzed with limited drill hole data available.
4. Numerous samples analyzed and data available from several drill holes.
5. Numerous samples analyzed and data available from many drill holes. Quarry development in some cases.

DEVELOPMENT PARAMETERS FOR ORDOVICIAN-SILURIAN LIMESTONE DEPOSITS IN NEW BRUNSWICK

DEPOSIT NAME: Hendry Brook-Belledune-Hodgin

N.T.S.: 21 P/12

DEVELOPMENT PARAMETERS		**RATING** 1	2	3	4	5
1.	Formation			X		
2.	Grade range	X				
3.	Grade continuity	X				
4.	Estimated reserves				X	
5.	Observed max./min. thickness		X			
6.	Estimated overburden				X	
7.	Dip ranges	X				
8.	Deposit access				X	
9A.	Ecologic location with respect to dwellings					X
9B.	Ecologic location with respect to waterways		X			
10.	Topographic setting				X	
11.	Level of exploration/ development			X		

DEPOSIT PRIORITY RATING (60 max.): 34

For a more detailed explanation concerning priority ratings see Development Parameters Scheme on adjacent page.

Development Parameters Scheme

Development Parameters	Rating Scheme (Parameter Modifiers) Point Assignment				
	1	2	3	4	5
1. Formation/Group	Tetagouche Hartin	Matapedia Carys Mills Siegas (Craig Brook)	Limestone Point La Vieille (Belle slate) Smyrna Mills	Petit Rocher	-
2. Grade range (CaO%)	40.0	40.0-45.0	45.0-50.0	50.0-53.0	>53.0
3. Grade continuity	Poor (extr.var.)	Poor to Moderate	Moderate (var.-constant)	Moderate to Good	Good (constant)
4. Estimated reserves (million tonnes)	Very Limited (<1)	Limited (1-3)	Large (3-10)	Very Large (10-20)	Extensive (>20)
5. Observed maximum thickness (m)	1-3	3-10	10-15	15-20	>20
6. Estimated average overburden (m)	>8	6-8	4-6	2-4	<2
7. Dip ranges (deg.)	<45	34-45	25-35	15-25	0-15
8. Deposit access*	Very poor	Poor	Moderate	Good	Excellent
9. Ecologic					
A. Location, main part of deposit with respect to 5 or more dwellings (km)	Proximal <1/2	Proximal/ Distant 1/2-1	Distant 1-2	Distant/ Remote 2-3	Remote >3
B. Location, main part of deposit with respect to waterways, swamps (km)	Proximal <1/2	Proximal/ Distant 1/2-1	Distant/ Remote 1/2-1	Distant/ Remote 1-2	Remote >2
10. Main topographic setting**	Very Poor	Poor	Good	Very Good	Excellent
11. Level of exploration/development***	Very Low	Low	Moderate	High	Very High

More detailed information on the ratings for designated parameters.

*
1. Several kilometres of new roads required over rough, forested terrain.
2. 1-2 km of new road required over rough, forested terrain.
3. Less than 1 km of new road required over rough, forested terrain.
4. Upgrading of existing road or 1 to 2 km of new road required over open fields, pastures, or lightly forested areas.
5. Within 0.5 km of a main road.

**
1. Very narrow quarry width and/or low-lying area with poor drainage.
2. Narrow quarry width exposed along very steep to cliff-like hillside, or adjacent a major waterway.
3. Narrow quarry width exposed along gently sloping to moderately steep hillside.
4. Reasonable quarry widths exposed along a gently sloping to moderately steep hillside.
5. Reasonable quarry width occurring near the crest of a hill. Excellent drainage.

***
1. None to only a few samples analyzed.
2. Several samples analyzed. No drill hole data available.
3. Several samples analyzed with limited drill hole data available.
4. Numerous samples analyzed and data available from several drill holes.
5. Numerous samples analyzed and data available from many drill holes. Quarry development in some cases.

DEVELOPMENT PARAMETERS FOR ORDOVICIAN-SILURIAN LIMESTONE DEPOSITS IN NEW BRUNSWICK

DEPOSIT NAME: Letang-Frye Island

N.T.S.: 21 G/2

DEVELOPMENT PARAMETERS		**RATING** 1	2	3	4	5
1.	Formation			X		
2.	Grade range			X		
3.	Grade continuity		X			
4.	Estimated reserves		X			
5.	Observed max./min. thickness		X			
6.	Estimated overburden					X
7.	Dip ranges	X				
8.	Deposit access					X
9A.	Ecologic location with respect to dwellings	X				
9B.	Ecologic location with respect to waterways	X				
10.	Topographic setting			X		
11.	Level of exploration/ development					X

DEPOSIT PRIORITY RATING (60 max.): 33

For a more detailed explanation concerning priority ratings see Development Parameters Scheme on adjacent page.

Development Parameters Scheme

Development Parameters	Rating Scheme (Parameter Modifiers) Point Assignment				
	1	2	3	4	5
1. Formation/Group	Tetagouche Hartin	Matapedia Carys Mills Siegas (Craig Brook)	Limestone Point La Vieille (Belle slate) Smyrna Mills	Petit Rocher	-
2. Grade range (CaO%)	40.0	40.0-45.0	45.0-50.0	50.0-53.0	>53.0
3. Grade continuity	Poor (extr.var.)	Poor to Moderate	Moderate (var.-constant)	Moderate to Good	Good (constant)
4. Estimated reserves (million tonnes)	Very Limited (<1)	Limited (1-3)	Large (3-10)	Very Large (10-20)	Extensive (>20)
5. Observed maximum thickness (m)	1-3	3-10	10-15	15-20	>20
6. Estimated average overburden (m)	>8	6-8	4-6	2-4	<2
7. Dip ranges (deg.)	<45	34-45	25-35	15-25	0-15
8. Deposit access*	Very poor	Poor	Moderate	Good	Excellent
9. Ecologic					
A. Location, main part of deposit with respect to 5 or more dwellings (km)	Proximal <1/2	Proximal/ Distant 1/2-1	Distant 1-2	Distant/ Remote 2-3	Remote >3
B. Location, main part of deposit with respect to waterways, swamps (km)	Proximal <1/2	Proximal/ Distant 1/2-1	Distant/ Remote 1/2-1	Distant/ Remote 1-2	Remote >2
10. Main topographic setting**	Very Poor	Poor	Good	Very Good	Excellent
11. Level of exploration/development***	Very Low	Low	Moderate	High	Very High

More detailed information on the ratings for designated parameters.

*
1. Several kilometres of new roads required over rough, forested terrain.
2. 1-2 km of new road required over rough, forested terrain.
3. Less than 1 km of new road required over rough, forested terrain.
4. Upgrading of existing road or 1 to 2 km of new road required over open fields, pastures, or lightly forested areas.
5. Within 0.5 km of a main road.

**
1. Very narrow quarry width and/or low-lying area with poor drainage.
2. Narrow quarry width exposed along very steep to cliff-like hillside, or adjacent a major waterway.
3. Narrow quarry width exposed along gently sloping to moderately steep hillside.
4. Reasonable quarry widths exposed along a gently sloping to moderately steep hillside.
5. Reasonable quarry width occurring near the crest of a hill. Excellent drainage.

***
1. None to only a few samples analyzed.
2. Several samples analyzed. No drill hole data available.
3. Several samples analyzed with limited drill hole data available.
4. Numerous samples analyzed and data available from several drill holes.
5. Numerous samples analyzed and data available from many drill holes. Quarry development in some cases.

DEVELOPMENT PARAMETERS FOR ORDOVICIAN-SILURIAN LIMESTONE DEPOSITS IN NEW BRUNSWICK

DEPOSIT NAME: Lincour

N.T.S.: 21 P/12

DEVELOPMENT PARAMETERS		RATING				
		1	2	3	4	5
1.	Formation	X				
2.	Grade range	X				
3.	Grade continuity			X		
4.	Estimated reserves	X				
5.	Observed max./min. thickness		X			
6.	Estimated overburden	X				
7.	Dip ranges	X				
8.	Deposit access				X	
9A.	Ecologic location with respect to dwellings					X
9B.	Ecologic location with respect to waterways			X		
10.	Topographic setting	X				
11.	Level of exploration/ development			X		

DEPOSIT PRIORITY RATING (60 max.): 27

For a more detailed explanation concerning priority ratings see Development Parameters Scheme on adjacent page.

Development Parameters Scheme

Development Parameters	Rating Scheme (Parameter Modifiers) Point Assignment				
	1	2	3	4	5
1. Formation/Group	Tetagouche Hartin	Matapedia Carys Mills Siegas (Craig Brook)	Limestone Point La Vieille (Belle slate) Smyrna Mills	Petit Rocher	-
2. Grade range (CaO%)	40.0	40.0-45.0	45.0-50.0	50.0-53.0	>53.0
3. Grade continuity	Poor (extr.var.)	Poor to Moderate	Moderate (var.-constant)	Moderate to Good	Good (constant)
4. Estimated reserves (million tonnes)	Very Limited (<1)	Limited (1-3)	Large (3-10)	Very Large (10-20)	Extensive (>20)
5. Observed maximum thickness (m)	1-3	3-10	10-15	15-20	>20
6. Estimated average overburden (m)	>8	6-8	4-6	2-4	<2
7. Dip ranges (deg.)	<45	34-45	25-35	15-25	0-15
8. Deposit access*	Very poor	Poor	Moderate	Good	Excellent
9. Ecologic					
A. Location, main part of deposit with respect to 5 or more dwellings (km)	Proximal <1/2	Proximal/ Distant 1/2-1	Distant 1-2	Distant/ Remote 2-3	Remote >3
B. Location, main part of deposit with respect to waterways, swamps (km)	Proximal <1/2	Proximal/ Distant 1/2-1	Distant/ Remote 1/2-1	Distant/ Remote 1-2	Remote >2
10. Main topographic setting**	Very Poor	Poor	Good	Very Good	Excellent
11. Level of exploration/development***	Very Low	Low	Moderate	High	Very High

More detailed information on the ratings for designated parameters.

*

1. Several kilometres of new roads required over rough, forested terrain.
2. 1-2 km of new road required over rough, forested terrain.
3. Less than 1 km of new road required over rough, forested terrain.
4. Upgrading of existing road or 1 to 2 km of new road required over open fields, pastures, or lightly forested areas.
5. Within 0.5 km of a main road.

**

1. Very narrow quarry width and/or low-lying area with poor drainage.
2. Narrow quarry width exposed along very steep to cliff-like hillside, or adjacent a major waterway.
3. Narrow quarry width exposed along gently sloping to moderately steep hillside.
4. Reasonable quarry widths exposed along a gently sloping to moderately steep hillside.
5. Reasonable quarry width occurring near the crest of a hill. Excellent drainage.

***

1. None to only a few samples analyzed.
2. Several samples analyzed. No drill hole data available.
3. Several samples analyzed with limited drill hole data available.
4. Numerous samples analyzed and data available from several drill holes.
5. Numerous samples analyzed and data available from many drill holes. Quarry development in some cases.

DEVELOPMENT PARAMETERS FOR ORDOVICIAN-SILURIAN LIMESTONE DEPOSITS IN NEW BRUNSWICK

DEPOSIT NAME: Nash Creek

N.T.S.: 21 O/16

DEVELOPMENT PARAMETERS		RATING				
		1	2	3	4	5
1.	Formation		X			
2.	Grade range		X			
3.	Grade continuity				X	
4.	Estimated reserves				X *	
5.	Observed max./min. thickness					X
6.	Estimated overburden				X	
7.	Dip ranges	X				
8.	Deposit access				X	
9A.	Ecologic location with repsect to dwellings			X		
9B.	Ecologic location with respect to waterways		X			
10.	Topographic setting			X		
11.	Level of exploration/ development	X				

DEPOSIT PRIORITY RATING (60 max.): 35(1)**

For a more detailed explanation concerning priority ratings see Development Parameters Scheme on adjacent page.

* x low level of confidence.

** (1) total number of low confidence parameters.

Development Parameters Scheme

Development Parameters	Rating Scheme (Parameter Modifiers) Point Assignment				
	1	2	3	4	5
1. Formation/Group	Tetagouche Hartin	Matapedia Carys Mills Siegas (Craig Brook)	Limestone Point La Vieille (Belle slate) Smyrna Mills	Petit Rocher	-
2. Grade range (CaO%)	40.0	40.0-45.0	45.0-50.0	50.0-53.0	>53.0
3. Grade continuity	Poor (extr.var.)	Poor to Moderate	Moderate (var.-constant)	Moderate to Good	Good (constant)
4. Estimated reserves (million tonnes)	Very Limited (<1)	Limited (1-3)	Large (3-10)	Very Large (10-20)	Extensive (>20)
5. Observed maximum thickness (m)	1-3	3-10	10-15	15-20	>20
6. Estimated average overburden (m)	>8	6-8	4-6	2-4	<2
7. Dip ranges (deg.)	<45	34-45	25-35	15-25	0-15
8. Deposit access*	Very poor	Poor	Moderate	Good	Excellent
9. Ecologic					
A. Location, main part of deposit with respect to 5 or more dwellings (km)	Proximal <1/2	Proximal/Distant 1/2-1	Distant 1-2	Distant/Remote 2-3	Remote >3
B. Location, main part of deposit with respect to waterways, swamps (km)	Proximal <1/2	Proximal/Distant 1/2-1	Distant/Remote 1/2-1	Distant/Remote 1-2	Remote >2
10. Main topographic setting**	Very Poor	Poor	Good	Very Good	Excellent
11. Level of exploration/development***	Very Low	Low	Moderate	High	Very High

More detailed information on the ratings for designated parameters.

*
1. Several kilometres of new roads required over rough, forested terrain.
2. 1-2 km of new road required over rough, forested terrain.
3. Less than 1 km of new road required over rough, forested terrain.
4. Upgrading of existing road or 1 to 2 km of new road required over open fields, pastures, or lightly forested areas.
5. Within 0.5 km of a main road.

**
1. Very narrow quarry width and/or low-lying area with poor drainage.
2. Narrow quarry width exposed along very steep to cliff-like hillside, or adjacent a major waterway.
3. Narrow quarry width exposed along gently sloping to moderately steep hillside.
4. Reasonable quarry widths exposed along a gently sloping to moderately steep hillside.
5. Reasonable quarry width occurring near the crest of a hill. Excellent drainage.

***
1. None to only a few samples analyzed.
2. Several samples analyzed. No drill hole data available.
3. Several samples analyzed with limited drill hole data available.
4. Numerous samples analyzed and data available from several drill holes.
5. Numerous samples analyzed and data available from many drill holes. Quarry development in some cases.

DEVELOPMENT PARAMETERS FOR ORDOVICIAN-SILURIAN LIMESTONE DEPOSITS IN NEW BRUNSWICK

DEPOSIT NAME: Peel

N.T.S.: 21 J/5

DEVELOPMENT PARAMETERS		**RATING** 1	2	3	4	5
1.	Formation			X		
2.	Grade range			X *		
3.	Grade continuity			X *		
4.	Estimated reserves			X *		
5.	Observed max./min. thickness		X *			
6.	Estimated overburden				X	
7.	Dip ranges	X				
8.	Deposit access					X
9A.	Ecologic location with respect to dwellings	X				
9B.	Ecologic location with respect to waterways		X			
10.	Topographic setting					X
11.	Level of exploration/ development	X				

DEPOSIT PRIORITY RATING (60 max.): 33(4)**

For a more detailed explanation concerning priority ratings see Development Parameters Scheme on adjacent page.

* low level of confidence.

** (4) total number of low confidence parameters.

Development Parameters Scheme

Development Parameters	Rating Scheme (Parameter Modifiers) Point Assignment				
	1	2	3	4	5
1. Formation/Group	Tetagouche Hartin	Matapedia Carys Mills Siegas (Craig Brook)	Limestone Point La Vieille (Belle slate) Smyrna Mills	Petit Rocher	-
2. Grade range (CaO%)	40.0	40.0-45.0	45.0-50.0	50.0-53.0	>53.0
3. Grade continuity	Poor (extr.var.)	Poor to Moderate	Moderate (var.-constant)	Moderate to Good	Good (constant)
4. Estimated reserves (million tonnes)	Very Limited (<1)	Limited (1-3)	Large (3-10)	Very Large (10-20)	Extensive (>20)
5. Observed maximum thickness (m)	1-3	3-10	10-15	15-20	>20
6. Estimated average overburden (m)	>8	6-8	4-6	2-4	<2
7. Dip ranges (deg.)	<45	34-45	25-35	15-25	0-15
8. Deposit access*	Very poor	Poor	Moderate	Good	Excellent
9. Ecologic					
A. Location, main part of deposit with respect to 5 or more dwellings (km)	Proximal <1/2	Proximal/Distant 1/2-1	Distant 1-2	Distant/Remote 2-3	Remote >3
B. Location, main part of deposit with respect to waterways, swamps (km)	Proximal <1/2	Proximal/Distant 1/2-1	Distant/Remote 1/2-1	Distant/Remote 1-2	Remote >2
10. Main topographic setting**	Very Poor	Poor	Good	Very Good	Excellent
11. Level of exploration/development***	Very Low	Low	Moderate	High	Very High

More detailed information on the ratings for designated parameters.

*

1. Several kilometres of new roads required over rough, forested terrain.
2. 1-2 km of new road required over rough, forested terrain.
3. Less than 1 km of new road required over rough, forested terrain.
4. Upgrading of existing road or 1 to 2 km of new road required over open fields, pastures, or lightly forested areas.
5. Within 0.5 km of a main road.

**

1. Very narrow quarry width and/or low-lying area with poor drainage.
2. Narrow quarry width exposed along very steep to cliff-like hillside, or adjacent a major waterway.
3. Narrow quarry width exposed along gently sloping to moderately steep hillside.
4. Reasonable quarry widths exposed along a gently sloping to moderately steep hillside.
5. Reasonable quarry width occurring near the crest of a hill. Excellent drainage.

***

1. None to only a few samples analyzed.
2. Several samples analyzed. No drill hole data available.
3. Several samples analyzed with limited drill hole data available.
4. Numerous samples analyzed and data available from several drill holes.
5. Numerous samples analyzed and data available from many drill holes. Quarry development in some cases.

DEVELOPMENT PARAMETERS FOR ORDOVICIAN-SILURIAN LIMESTONE DEPOSITS IN NEW BRUNSWICK

DEPOSIT NAME: Pointe La Roche

N.T.S.: 21 O/6

DEVELOPMENT PARAMETERS		RATING				
		1	2	3	4	5
1.	Formation			X		
2.	Grade range		X			
3.	Grade continuity	X				
4.	Estimated reserves			X		
5.	Observed max./min. thickness		X			
6.	Estimated overburden				X	
7.	Dip ranges	X				
8.	Deposit access				X	
9A.	Ecologic location with respect to dwellings			X		
9B.	Ecologic location with respect to waterways			X		
10.	Topographic setting			X		
11.	Level of exploration/ development	X				

DEPOSIT PRIORITY RATING (60 max.): 30

For a more detailed explanation concerning priority ratings see Development Parameters Scheme on adjacent page.

Development Parameters Scheme

Development Parameters	Rating Scheme (Parameter Modifiers) Point Assignment				
	1	2	3	4	5
1. Formation/Group	Tetagouche Hartin	Matapedia Carys Mills Siegas (Craig Brook)	Limestone Point La Vieille (Belle slate) Smyrna Mills	Petit Rocher	-
2. Grade range (CaO%)	40.0	40.0-45.0	45.0-50.0	50.0-53.0	>53.0
3. Grade continuity	Poor (extr.var.)	Poor to Moderate	Moderate (var.-constant)	Moderate to Good	Good (constant)
4. Estimated reserves (million tonnes)	Very Limited (<1)	Limited (1-3)	Large (3-10)	Very Large (10-20)	Extensive (>20)
5. Observed maximum thickness (m)	1-3	3-10	10-15	15-20	>20
6. Estimated average overburden (m)	>8	6-8	4-6	2-4	<2
7. Dip ranges (deg.)	<45	34-45	25-35	15-25	0-15
8. Deposit access*	Very poor	Poor	Moderate	Good	Excellent
9. Ecologic					
A. Location, main part of deposit with respect to 5 or more dwellings (km)	Proximal <1/2	Proximal/ Distant 1/2-1	Distant 1-2	Distant/ Remote 2-3	Remote >3
B. Location, main part of deposit with respect to waterways, swamps (km)	Proximal <1/2	Proximal/ Distant 1/2-1	Distant/ Remote 1/2-1	Distant/ Remote 1-2	Remote >2
10. Main topographic setting**	Very Poor	Poor	Good	Very Good	Excellent
11. Level of exploration/development***	Very Low	Low	Moderate	High	Very High

More detailed information on the ratings for designated parameters.

*

1. Several kilometres of new roads required over rough, forested terrain.
2. 1-2 km of new road required over rough, forested terrain.
3. Less than 1 km of new road required over rough, forested terrain.
4. Upgrading of existing road or 1 to 2 km of new road required over open fields, pastures, or lightly forested areas.
5. Within 0.5 km of a main road.

**

1. Very narrow quarry width and/or low-lying area with poor drainage.
2. Narrow quarry width exposed along very steep to cliff-like hillside, or adjacent a major waterway.
3. Narrow quarry width exposed along gently sloping to moderately steep hillside.
4. Reasonable quarry widths exposed along a gently sloping to moderately steep hillside.
5. Reasonable quarry width occurring near the crest of a hill. Excellent drainage.

***

1. None to only a few samples analyzed.
2. Several samples analyzed. No drill hole data available.
3. Several samples analyzed with limited drill hole data available.
4. Numerous samples analyzed and data available from several drill holes.
5. Numerous samples analyzed and data available from many drill holes. Quarry development in some cases.

DEVELOPMENT PARAMETERS FOR ORDOVICIAN-SILURIAN LIMESTONE DEPOSITS IN NEW BRUNSWICK

DEPOSIT NAME: Quinn Point-Culligan

N.T.S.: 21 P/13

DEVELOPMENT PARAMETERS		RATING				
		1	2	3	4	5
1.	Formation			X		
2.	Grade range		X			
3.	Grade continuity	X				
4.	Estimated reserves			X		
5.	Observed max./min. thickness			X		
6.	Estimated overburden				X	
7.	Dip ranges		X			
8.	Deposit access				X	
9A.	Ecologic location with respect to dwellings		X			
9B.	Ecologic location with respect to waterways				X	
10.	Topographic setting				X	
11.	Level of exploration/ development		X			

DEPOSIT PRIORITY RATING (60 max.): 34

For a more detailed explanation concerning priority ratings see Development Parameters Scheme on adjacent page.

Development Parameters Scheme

Development Parameters	Rating Scheme (Parameter Modifiers) Point Assignment				
	1	2	3	4	5
1. Formation/Group	Tetagouche Hartin	Matapedia Carys Mills Siegas (Craig Brook)	Limestone Point La Vieille (Belle slate) Smyrna Mills	Petit Rocher	-
2. Grade range (CaO%)	40.0	40.0-45.0	45.0-50.0	50.0-53.0	>53.0
3. Grade continuity	Poor (extr.var.)	Poor to Moderate	Moderate (var.-constant)	Moderate to Good	Good (constant)
4. Estimated reserves (million tonnes)	Very Limited (<1)	Limited (1-3)	Large (3-10)	Very Large (10-20)	Extensive (>20)
5. Observed maximum thickness (m)	1-3	3-10	10-15	15-20	>20
6. Estimated average overburden (m)	>8	6-8	4-6	2-4	<2
7. Dip ranges (deg.)	<45	34-45	25-35	15-25	0-15
8. Deposit access*	Very poor	Poor	Moderate	Good	Excellent
9. Ecologic					
A. Location, main part of deposit with respect to 5 or more dwellings (km)	Proximal <1/2	Proximal/ Distant 1/2-1	Distant 1-2	Distant/ Remote 2-3	Remote >3
B. Location, main part of deposit with respect to waterways, swamps (km)	Proximal <1/2	Proximal/ Distant 1/2-1	Distant/ Remote 1/2-1	Distant/ Remote 1-2	Remote >2
10. Main topographic setting**	Very Poor	Poor	Good	Very Good	Excellent
11. Level of exploration/development***	Very Low	Low	Moderate	High	Very High

More detailed information on the ratings for designated parameters.

*
1. Several kilometres of new roads required over rough, forested terrain.
2. 1-2 km of new road required over rough, forested terrain.
3. Less than 1 km of new road required over rough, forested terrain.
4. Upgrading of existing road or 1 to 2 km of new road required over open fields, pastures, or lightly forested areas.
5. Within 0.5 km of a main road.

**
1. Very narrow quarry width and/or low-lying area with poor drainage.
2. Narrow quarry width exposed along very steep to cliff-like hillside, or adjacent a major waterway.
3. Narrow quarry width exposed along gently sloping to moderately steep hillside.
4. Reasonable quarry widths exposed along a gently sloping to moderately steep hillside.
5. Reasonable quarry width occurring near the crest of a hill. Excellent drainage.

***
1. None to only a few samples analyzed.
2. Several samples analyzed. No drill hole data available.
3. Several samples analyzed with limited drill hole data available.
4. Numerous samples analyzed and data available from several drill holes.
5. Numerous samples analyzed and data available from many drill holes. Quarry development in some cases.

DEVELOPMENT PARAMETERS FOR ORDOVICIAN-SILURIAN LIMESTONE DEPOSITS IN NEW BRUNSWICK

DEPOSIT NAME: Salmon River

N.T.S.: 21 O/4

	DEVELOPMENT PARAMETERS	**RATING** 1	2	3	4	5
1.	Formation			X *		
2.	Grade range	X				
3.	Grade continuity			X *		
4.	Estimated reserves	X				
5.	Observed max./min. thickness		X *			
6.	Estimated overburden					X *
7.	Dip ranges	X				
8.	Deposit access				X	
9A.	Ecologic location with respect to dwellings	X				
9B.	Ecologic location with respect to waterways	X				
10.	Topographic setting		X			
11.	Level of exploration/ development	X				

DEPOSIT PRIORITY RATING (60 max.): 25$^{(4)**}$

For a more detailed explanation concerning priority ratings see Development Parameters Scheme on adjacent page.

* low level of confidence.

** (4) total number of low confidence parameters.

Development Parameters Scheme

Development Parameters	Rating Scheme (Parameter Modifiers) Point Assignment				
	1	2	3	4	5
1. Formation/Group	Tetagouche Hartin	Matapedia Carys Mills Siegas (Craig Brook)	Limestone Point La Vieille (Belle slate) Smyrna Mills	Petit Rocher	-
2. Grade range (CaO%)	40.0	40.0-45.0	45.0-50.0	50.0-53.0	>53.0
3. Grade continuity	Poor (extr.var.)	Poor to Moderate	Moderate (var.-constant)	Moderate to Good	Good (constant)
4. Estimated reserves (million tonnes)	Very Limited (<1)	Limited (1-3)	Large (3-10)	Very Large (10-20)	Extensive (>20)
5. Observed maximum thickness (m)	1-3	3-10	10-15	15-20	>20
6. Estimated average overburden (m)	>8	6-8	4-6	2-4	<2
7. Dip ranges (deg.)	<45	34-45	25-35	15-25	0-15
8. Deposit access*	Very poor	Poor	Moderate	Good	Excellent
9. Ecologic					
A. Location, main part of deposit with respect to 5 or more dwellings (km)	Proximal <1/2	Proximal/ Distant 1/2-1	Distant 1-2	Distant/ Remote 2-3	Remote >3
B. Location, main part of deposit with respect to waterways, swamps (km)	Proximal <1/2	Proximal/ Distant 1/2-1	Distant/ Remote 1/2-1	Distant/ Remote 1-2	Remote >2
10. Main topographic setting**	Very Poor	Poor	Good	Very Good	Excellent
11. Level of exploration/development***	Very Low	Low	Moderate	High	Very High

More detailed information on the ratings for designated parameters.

*
1. Several kilometres of new roads required over rough, forested terrain.
2. 1-2 km of new road required over rough, forested terrain.
3. Less than 1 km of new road required over rough, forested terrain.
4. Upgrading of existing road or 1 to 2 km of new road required over open fields, pastures, or lightly forested areas.
5. Within 0.5 km of a main road.

**
1. Very narrow quarry width and/or low-lying area with poor drainage.
2. Narrow quarry width exposed along very steep to cliff-like hillside, or adjacent a major waterway.
3. Narrow quarry width exposed along gently sloping to moderately steep hillside.
4. Reasonable quarry widths exposed along a gently sloping to moderately steep hillside.
5. Reasonable quarry width occurring near the crest of a hill. Excellent drainage.

***
1. None to only a few samples analyzed.
2. Several samples analyzed. No drill hole data available.
3. Several samples analyzed with limited drill hole data available.
4. Numerous samples analyzed and data available from several drill holes.
5. Numerous samples analyzed and data available from many drill holes. Quarry development in some cases.

DEVELOPMENT PARAMETERS FOR ORDOVICIAN-SILURIAN LIMESTONE DEPOSITS IN NEW BRUNSWICK

DEPOSIT NAME: Siegas

N.T.S.: 21 O/4

DEVELOPMENT PARAMETERS		**RATING**				
		1	**2**	**3**	**4**	**5**
1.	Formation		X			
2.	Grade range		X			
3.	Grade continuity		X			
4.	Estimated reserves	X				
5.	Observed max./min. thickness				X	
6.	Estimated overburden				X	
7.	Dip ranges	X				
8.	Deposit access					X
9A.	Ecologic location with respect to dwellings	X				
9B.	Ecologic location with respect to waterways		X			
10.	Topographic setting			X		
11.	Level of exploration/ development				X	

DEPOSIT PRIORITY RATING (60 max.): 31

For a more detailed explanation concerning priority ratings see Development Parameters Scheme on adjacent page.

Development Parameters Scheme

Development Parameters	Rating Scheme (Parameter Modifiers) Point Assignment				
	1	2	3	4	5
1. Formation/Group	Tetagouche Hartin	Matapedia Carys Mills Siegas (Craig Brook)	Limestone Point La Vieille (Belle slate) Smyrna Mills	Petit Rocher	-
2. Grade range (CaO%)	40.0	40.0-45.0	45.0-50.0	50.0-53.0	>53.0
3. Grade continuity	Poor (extr.var.)	Poor to Moderate	Moderate (var.-constant)	Moderate to Good	Good (constant)
4. Estimated reserves (million tonnes)	Very Limited (<1)	Limited (1-3)	Large (3-10)	Very Large (10-20)	Extensive (>20)
5. Observed maximum thickness (m)	1-3	3-10	10-15	15-20	>20
6. Estimated average overburden (m)	>8	6-8	4-6	2-4	<2
7. Dip ranges (deg.)	<45	34-45	25-35	15-25	0-15
8. Deposit access*	Very poor	Poor	Moderate	Good	Excellent
9. Ecologic					
A. Location, main part of deposit with respect to 5 or more dwellings (km)	Proximal <1/2	Proximal/ Distant 1/2-1	Distant 1-2	Distant/ Remote 2-3	Remote >3
B. Location, main part of deposit with respect to waterways, swamps (km)	Proximal <1/2	Proximal/ Distant 1/2-1	Distant/ Remote 1/2-1	Distant/ Remote 1-2	Remote >2
10. Main topographic setting**	Very Poor	Poor	Good	Very Good	Excellent
11. Level of exploration/development***	Very Low	Low	Moderate	High	Very High

More detailed information on the ratings for designated parameters.

*
1. Several kilometres of new roads required over rough, forested terrain.
2. 1-2 km of new road required over rough, forested terrain.
3. Less than 1 km of new road required over rough, forested terrain.
4. Upgrading of existing road or 1 to 2 km of new road required over open fields, pastures, or lightly forested areas.
5. Within 0.5 km of a main road.

**
1. Very narrow quarry width and/or low-lying area with poor drainage.
2. Narrow quarry width exposed along very steep to cliff-like hillside, or adjacent a major waterway.
3. Narrow quarry width exposed along gently sloping to moderately steep hillside.
4. Reasonable quarry widths exposed along a gently sloping to moderately steep hillside.
5. Reasonable quarry width occurring near the crest of a hill. Excellent drainage.

***
1. None to only a few samples analyzed.
2. Several samples analyzed. No drill hole data available.
3. Several samples analyzed with limited drill hole data available.
4. Numerous samples analyzed and data available from several drill holes.
5. Numerous samples analyzed and data available from many drill holes. Quarry development in some cases.

DEVELOPMENT PARAMETERS FOR ORDOVICIAN-SILURIAN LIMESTONE DEPOSITS IN NEW BRUNSWICK

DEPOSIT NAME: South Branch Millstream-Lower Tetagouche Lake

N.T.S.: 21 O/9

	DEVELOPMENT PARAMETERS	**RATING** 1	 2	 3	 4	 5
1.	Formation				X	
2.	Grade range				X	
3.	Grade continuity				X	
4.	Estimated reserves		X			
5.	Observed max./min. thickness		X			
6.	Estimated overburden			X		
7.	Dip ranges	X				
8.	Deposit access		X			
9A.	Ecologic location with respect to dwellings					X
9B.	Ecologic location with respect to waterways		X			
10.	Topographic setting			X		
11.	Level of exploration/ development				X	

DEPOSIT PRIORITY RATING (60 max.): 36

For a more detailed explanation concerning priority ratings see Development Parameters Scheme on adjacent page.

Development Parameters Scheme

Development Parameters	Rating Scheme (Parameter Modifiers) Point Assignment				
	1	2	3	4	5
1. Formation/Group	Tetagouche Hartin	Matapedia Carys Mills Siegas (Craig Brook)	Limestone Point La Vieille (Belle slate) Smyrna Mills	Petit Rocher	-
2. Grade range (CaO%)	40.0	40.0-45.0	45.0-50.0	50.0-53.0	>53.0
3. Grade continuity	Poor (extr.var.)	Poor to Moderate	Moderate (var.-constant)	Moderate to Good	Good (constant)
4. Estimated reserves (million tonnes)	Very Limited (<1)	Limited (1-3)	Large (3-10)	Very Large (10-20)	Extensive (>20)
5. Observed maximum thickness (m)	1-3	3-10	10-15	15-20	>20
6. Estimated average overburden (m)	>8	6-8	4-6	2-4	<2
7. Dip ranges (deg.)	<45	34-45	25-35	15-25	0-15
8. Deposit access*	Very poor	Poor	Moderate	Good	Excellent
9. Ecologic					
A. Location, main part of deposit with respect to 5 or more dwellings (km)	Proximal <1/2	Proximal/ Distant 1/2-1	Distant 1-2	Distant/ Remote 2-3	Remote >3
B. Location, main part of deposit with respect to waterways, swamps (km)	Proximal <1/2	Proximal/ Distant 1/2-1	Distant/ Remote 1/2-1	Distant/ Remote 1-2	Remote >2
10. Main topographic setting**	Very Poor	Poor	Good	Very Good	Excellent
11. Level of exploration/development***	Very Low	Low	Moderate	High	Very High

More detailed information on the ratings for designated parameters.

*
1. Several kilometres of new roads required over rough, forested terrain.
2. 1-2 km of new road required over rough, forested terrain.
3. Less than 1 km of new road required over rough, forested terrain.
4. Upgrading of existing road or 1 to 2 km of new road required over open fields, pastures, or lightly forested areas.
5. Within 0.5 km of a main road.

**
1. Very narrow quarry width and/or low-lying area with poor drainage.
2. Narrow quarry width exposed along very steep to cliff-like hillside, or adjacent a major waterway.
3. Narrow quarry width exposed along gently sloping to moderately steep hillside.
4. Reasonable quarry widths exposed along a gently sloping to moderately steep hillside.
5. Reasonable quarry width occurring near the crest of a hill. Excellent drainage.

***
1. None to only a few samples analyzed.
2. Several samples analyzed. No drill hole data available.
3. Several samples analyzed with limited drill hole data available.
4. Numerous samples analyzed and data available from several drill holes.
5. Numerous samples analyzed and data available from many drill holes. Quarry development in some cases.

DEVELOPMENT PARAMETERS FOR ORDOVICIAN-SILURIAN LIMESTONE DEPOSITS IN NEW BRUNSWICK

DEPOSIT NAME: South Charlo River

N.T.S.: 21 O/15, O/16, O/10

DEVELOPMENT PARAMETERS		RATING				
		1	2	3	4	5
1.	Formation			X		
2.	Grade range		X			
3.	Grade continuity	X				
4.	Estimated reserves			X *		
5.	Observed max./min. thickness		X *			
6.	Estimated overburden				X *	
7.	Dip ranges	X				
8.	Deposit access					X
9A.	Ecologic location with respect to dwellings					X
9B.	Ecologic location with respect to waterways		X			
10.	Topographic setting		X			
11.	Level of exploration/ development	X				

DEPOSIT PRIORITY RATING (60 max.): 31(3)**

For a more detailed explanation concerning priority ratings see Development Parameters Scheme on adjacent page.

*	low level of confidence.
** (3)	total number of low confidence parameters.

Development Parameters Scheme

Development Parameters	Rating Scheme (Parameter Modifiers) Point Assignment				
	1	2	3	4	5
1. Formation/Group	Tetagouche Hartin	Matapedia Carys Mills Siegas (Craig Brook)	Limestone Point La Vieille (Belle slate) Smyrna Mills	Petit Rocher	-
2. Grade range (CaO%)	40.0	40.0-45.0	45.0-50.0	50.0-53.0	>53.0
3. Grade continuity	Poor (extr.var.)	Poor to Moderate	Moderate (var.-constant)	Moderate to Good	Good (constant)
4. Estimated reserves (million tonnes)	Very Limited (<1)	Limited (1-3)	Large (3-10)	Very Large (10-20)	Extensive (>20)
5. Observed maximum thickness (m)	1-3	3-10	10-15	15-20	>20
6. Estimated average overburden (m)	>8	6-8	4-6	2-4	<2
7. Dip ranges (deg.)	<45	34-45	25-35	15-25	0-15
8. Deposit access*	Very poor	Poor	Moderate	Good	Excellent
9. Ecologic					
A. Location, main part of deposit with respect to 5 or more dwellings (km)	Proximal <1/2	Proximal/ Distant 1/2-1	Distant 1-2	Distant/ Remote 2-3	Remote >3
B. Location, main part of deposit with respect to waterways, swamps (km)	Proximal <1/2	Proximal/ Distant 1/2-1	Distant/ Remote 1/2-1	Distant/ Remote 1-2	Remote >2
10. Main topographic setting**	Very Poor	Poor	Good	Very Good	Excellent
11. Level of exploration/development***	Very Low	Low	Moderate	High	Very High

More detailed information on the ratings for designated parameters.

*
1. Several kilometres of new roads required over rough, forested terrain.
2. 1-2 km of new road required over rough, forested terrain.
3. Less than 1 km of new road required over rough, forested terrain.
4. Upgrading of existing road or 1 to 2 km of new road required over open fields, pastures, or lightly forested areas.
5. Within 0.5 km of a main road.

**
1. Very narrow quarry width and/or low-lying area with poor drainage.
2. Narrow quarry width exposed along very steep to cliff-like hillside, or adjacent a major waterway.
3. Narrow quarry width exposed along gently sloping to moderately steep hillside.
4. Reasonable quarry widths exposed along a gently sloping to moderately steep hillside.
5. Reasonable quarry width occurring near the crest of a hill. Excellent drainage.

***
1. None to only a few samples analyzed.
2. Several samples analyzed. No drill hole data available.
3. Several samples analyzed with limited drill hole data available.
4. Numerous samples analyzed and data available from several drill holes.
5. Numerous samples analyzed and data available from many drill holes. Quarry development in some cases.

DEVELOPMENT PARAMETERS FOR ORDOVICIAN-SILURIAN LIMESTONE DEPOSITS IN NEW BRUNSWICK

DEPOSIT NAME: Tetagouche River-Armstrong Brook

N.T.S.: 21 P/12

DEVELOPMENT PARAMETERS		RATING				
		1	2	3	4	5
1.	Formation	X				
2.	Grade range	X				
3.	Grade continuity				X	
4.	Estimated reserves	X				
5.	Observed max./min. thickness		X			
6.	Estimated overburden					X
7.	Dip ranges	X				
8.	Deposit access					X
9A.	Ecologic location with respect to dwellings				X	
9B.	Ecologic location with respect to waterways		X			
10.	Topographic setting			X		
11.	Level of exploration/ development				X	

DEPOSIT PRIORITY RATING (60 max.): 33

for a more detailed explanation concerning priority ratings see Development Parameters Scheme on adjacent page.

Development Parameters Scheme

Development Parameters	Rating Scheme (Parameter Modifiers) Point Assignment				
	1	2	3	4	5
1. Formation/Group	Tetagouche Hartin	Matapedia Carys Mills Siegas (Craig Brook)	Limestone Point La Vieille (Belle slate) Smyrna Mills	Petit Rocher	-
2. Grade range (CaO%)	40.0	40.0-45.0	45.0-50.0	50.0-53.0	>53.0
3. Grade continuity	Poor (extr.var.)	Poor to Moderate	Moderate (var.-constant)	Moderate to Good	Good (constant)
4. Estimated reserves (million tonnes)	Very Limited (<1)	Limited (1-3)	Large (3-10)	Very Large (10-20)	Extensive (>20)
5. Observed maximum thickness (m)	1-3	3-10	10-15	15-20	>20
6. Estimated average overburden (m)	>8	6-8	4-6	2-4	<2
7. Dip ranges (deg.)	<45	34-45	25-35	15-25	0-15
8. Deposit access*	Very poor	Poor	Moderate	Good	Excellent
9. Ecologic					
A. Location, main part of deposit with respect to 5 or more dwellings (km)	Proximal <1/2	Proximal/ Distant 1/2-1	Distant 1-2	Distant/ Remote 2-3	Remote >3
B. Location, main part of deposit with respect to waterways, swamps (km)	Proximal <1/2	Proximal/ Distant 1/2-1	Distant/ Remote 1/2-1	Distant/ Remote 1-2	Remote >2
10. Main topographic setting**	Very Poor	Poor	Good	Very Good	Excellent
11. Level of exploration/development***	Very Low	Low	Moderate	High	Very High

More detailed information on the ratings for designated parameters.

*
1. Several kilometres of new roads required over rough, forested terrain.
2. 1-2 km of new road required over rough, forested terrain.
3. Less than 1 km of new road required over rough, forested terrain.
4. Upgrading of existing road or 1 to 2 km of new road required over open fields, pastures, or lightly forested areas.
5. Within 0.5 km of a main road.

**
1. Very narrow quarry width and/or low-lying area with poor drainage.
2. Narrow quarry width exposed along very steep to cliff-like hillside, or adjacent a major waterway.
3. Narrow quarry width exposed along gently sloping to moderately steep hillside.
4. Reasonable quarry widths exposed along a gently sloping to moderately steep hillside.
5. Reasonable quarry width occurring near the crest of a hill. Excellent drainage.

***
1. None to only a few samples analyzed.
2. Several samples analyzed. No drill hole data available.
3. Several samples analyzed with limited drill hole data available.
4. Numerous samples analyzed and data available from several drill holes.
5. Numerous samples analyzed and data available from many drill holes. Quarry development in some cases.

DEVELOPMENT PARAMETERS FOR ORDOVICIAN-SILURIAN LIMESTONE DEPOSITS IN NEW BRUNSWICK

DEPOSIT NAME: Tetagouche River-Armstrong Brook

N.T.S.: 21 P/12

DEVELOPMENT PARAMETERS		**RATING**				
		1	**2**	**3**	**4**	**5**
1.	Formation	X				
2.	Grade range	X				
3.	Grade continuity		X			
4.	Estimated reserves	X				
5.	Observed max./min. thickness		X *			
6.	Estimated overburden				X	
7.	Dip ranges	X				
8.	Deposit access	X				
9A.	Ecologic location with respect to dwellings					X
9B.	Ecologic location with respect to waterways	X				
10.	Topographic setting		X			
11.	Level of exploration/ development	X				

DEPOSIT PRIORITY RATING (60 max.): 22(1)**

For a more detailed explanation concerning priority ratings see Development Parameters Scheme on adjacent page.

* low level of confidence.
** (1) total number of low confidence parameters.

Development Parameters Scheme

Development Parameters	Rating Scheme (Parameter Modifiers) Point Assignment				
	1	2	3	4	5
1. Formation/Group	Tetagouche Hartin	Matapedia Carys Mills Siegas (Craig Brook)	Limestone Point La Vieille (Belle slate) Smyrna Mills	Petit Rocher	-
2. Grade range (CaO%)	40.0	40.0-45.0	45.0-50.0	50.0-53.0	>53.0
3. Grade continuity	Poor (extr.var.)	Poor to Moderate	Moderate (var.-constant)	Moderate to Good	Good (constant)
4. Estimated reserves (million tonnes)	Very Limited (<1)	Limited (1-3)	Large (3-10)	Very Large (10-20)	Extensive (>20)
5. Observed maximum thickness (m)	1-3	3-10	10-15	15-20	>20
6. Estimated average overburden (m)	>8	6-8	4-6	2-4	<2
7. Dip ranges (deg.)	<45	34-45	25-35	15-25	0-15
8. Deposit access*	Very poor	Poor	Moderate	Good	Excellent
9. Ecologic					
A. Location, main part of deposit with respect to 5 or more dwellings (km)	Proximal <1/2	Proximal/ Distant 1/2-1	Distant 1-2	Distant/ Remote 2-3	Remote >3
B. Location, main part of deposit with respect to waterways, swamps (km)	Proximal <1/2	Proximal/ Distant 1/2-1	Distant/ Remote 1/2-1	Distant/ Remote 1-2	Remote >2
10. Main topographic setting**	Very Poor	Poor	Good	Very Good	Excellent
11. Level of exploration/development***	Very Low	Low	Moderate	High	Very High

More detailed information on the ratings for designated parameters.

*
1. Several kilometres of new roads required over rough, forested terrain.
2. 1-2 km of new road required over rough, forested terrain.
3. Less than 1 km of new road required over rough, forested terrain.
4. Upgrading of existing road or 1 to 2 km of new road required over open fields, pastures, or lightly forested areas.
5. Within 0.5 km of a main road.

**
1. Very narrow quarry width and/or low-lying area with poor drainage.
2. Narrow quarry width exposed along very steep to cliff-like hillside, or adjacent a major waterway.
3. Narrow quarry width exposed along gently sloping to moderately steep hillside.
4. Reasonable quarry widths exposed along a gently sloping to moderately steep hillside.
5. Reasonable quarry width occurring near the crest of a hill. Excellent drainage.

***
1. None to only a few samples analyzed.
2. Several samples analyzed. No drill hole data available.
3. Several samples analyzed with limited drill hole data available.
4. Numerous samples analyzed and data available from several drill holes.
5. Numerous samples analyzed and data available from many drill holes. Quarry development in some cases.

DEVELOPMENT PARAMETERS FOR ORDOVICIAN-SILURIAN LIMESTONE DEPOSITS IN NEW BRUNSWICK

DEPOSIT NAME: Upsalquitch Forks

N.T.S.: 21 O/10

DEVELOPMENT PARAMETERS		**RATING**				
		1	2	3	4	5
1.	Formation		X			
2.	Grade range		X *			
3.	Grade continuity		X *			
4.	Estimated reserves			X *		
5.	Observed max./min. thickness		X *			
6.	Estimated overburden				X *	
7.	Dip ranges				X *	
8.	Deposit access			X		
9A.	Ecologic location with respect to dwellings					X
9B.	Ecologic location with respect to waterways		X			
10.	Topographic setting				X	
11.	Level of exploration/ development		X			

DEPOSIT PRIORITY RATING (60 max.): $34^{(6)**}$

For a more detailed explanation concerning priority ratings see Development Parameters Scheme on adjacent page.

* low level of confidence.

** (6) total number of low confidence parameters.

Development Parameters Scheme

Development Parameters	Rating Scheme (Parameter Modifiers) Point Assignment				
	1	2	3	4	5
1. Formation/Group	Tetagouche Hartin	Matapedia Carys Mills Siegas (Craig Brook)	Limestone Point La Vieille (Belle slate) Smyrna Mills	Petit Rocher	-
2. Grade range (CaO%)	40.0	40.0-45.0	45.0-50.0	50.0-53.0	>53.0
3. Grade continuity	Poor (extr.var.)	Poor to Moderate	Moderate (var.-constant)	Moderate to Good	Good (constant)
4. Estimated reserves (million tonnes)	Very Limited (<1)	Limited (1-3)	Large (3-10)	Very Large (10-20)	Extensive (>20)
5. Observed maximum thickness (m)	1-3	3-10	10-15	15-20	>20
6. Estimated average overburden (m)	>8	6-8	4-6	2-4	<2
7. Dip ranges (deg.)	<45	34-45	25-35	15-25	0-15
8. Deposit access*	Very poor	Poor	Moderate	Good	Excellent
9. Ecologic					
A. Location, main part of deposit with respect to 5 or more dwellings (km)	Proximal <1/2	Proximal/ Distant 1/2-1	Distant 1-2	Distant/ Remote 2-3	Remote >3
B. Location, main part of deposit with respect to waterways, swamps (km)	Proximal <1/2	Proximal/ Distant 1/2-1	Distant/ Remote 1/2-1	Distant/ Remote 1-2	Remote >2
10. Main topographic setting**	Very Poor	Poor	Good	Very Good	Excellent
11. Level of exploration/development***	Very Low	Low	Moderate	High	Very High

More detailed information on the ratings for designated parameters.

*
1. Several kilometres of new roads required over rough, forested terrain.
2. 1-2 km of new road required over rough, forested terrain.
3. Less than 1 km of new road required over rough, forested terrain.
4. Upgrading of existing road or 1 to 2 km of new road required over open fields, pastures, or lightly forested areas.
5. Within 0.5 km of a main road.

**
1. Very narrow quarry width and/or low-lying area with poor drainage.
2. Narrow quarry width exposed along very steep to cliff-like hillside, or adjacent a major waterway.
3. Narrow quarry width exposed along gently sloping to moderately steep hillside.
4. Reasonable quarry widths exposed along a gently sloping to moderately steep hillside.
5. Reasonable quarry width occurring near the crest of a hill. Excellent drainage.

***
1. None to only a few samples analyzed.
2. Several samples analyzed. No drill hole data available.
3. Several samples analyzed with limited drill hole data available.
4. Numerous samples analyzed and data available from several drill holes.
5. Numerous samples analyzed and data available from many drill holes. Quarry development in some cases.

DEVELOPMENT PARAMETERS FOR ORDOVICIAN-SILURIAN LIMESTONE DEPOSITS IN NEW BRUNSWICK

DEPOSIT NAME: (Central) Waterville

N.T.S.: 21 J/3

DEVELOPMENT PARAMETERS		**RATING**				
		1	**2**	**3**	**4**	**5**
1.	Formation		X			
2.	Grade range					X
3.	Grade continuity			X		
4.	Estimated reserves	X				
5.	Observed max./min. thickness			X		
6.	Estimated overburden				X	
7.	Dip ranges	X				
8.	Deposit access					X
9A.	Ecologic location with respect to dwellings		X			
9B.	Ecologic location with respect to waterways					X
10.	Topographic setting			X		
11.	Level of exploration/ development					X

DEPOSIT PRIORITY RATING (60 max.): 34

For a more detailed explanation concerning priority ratings see Development Parameters Scheme on adjacent page.

Development Parameters Scheme

Development Parameters	Rating Scheme (Parameter Modifiers) Point Assignment				
	1	2	3	4	5
1. Formation/Group	Tetagouche Hartin	Matapedia Carys Mills Siegas (Craig Brook)	Limestone Point La Vieille (Belle slate) Smyrna Mills	Petit Rocher	-
2. Grade range (CaO%)	40.0	40.0-45.0	45.0-50.0	50.0-53.0	>53.0
3. Grade continuity	Poor (extr.var.)	Poor to Moderate	Moderate (var.-constant)	Moderate to Good	Good (constant)
4. Estimated reserves (million tonnes)	Very Limited (<1)	Limited (1-3)	Large (3-10)	Very Large (10-20)	Extensive (>20)
5. Observed maximum thickness (m)	1-3	3-10	10-15	15-20	>20
6. Estimated average overburden (m)	>8	6-8	4-6	2-4	<2
7. Dip ranges (deg.)	<45	34-45	25-35	15-25	0-15
8. Deposit access*	Very poor	Poor	Moderate	Good	Excellent
9. Ecologic					
A. Location, main part of deposit with respect to 5 or more dwellings (km)	Proximal <1/2	Proximal/ Distant 1/2-1	Distant 1-2	Distant/ Remote 2-3	Remote >3
B. Location, main part of deposit with respect to waterways, swamps (km)	Proximal <1/2	Proximal/ Distant 1/2-1	Distant/ Remote 1/2-1	Distant/ Remote 1-2	Remote >2
10. Main topographic setting**	Very Poor	Poor	Good	Very Good	Excellent
11. Level of exploration/development***	Very Low	Low	Moderate	High	Very High

More detailed information on the ratings for designated parameters.

*

1. Several kilometres of new roads required over rough, forested terrain.
2. 1-2 km of new road required over rough, forested terrain.
3. Less than 1 km of new road required over rough, forested terrain.
4. Upgrading of existing road or 1 to 2 km of new road required over open fields, pastures, or lightly forested areas.
5. Within 0.5 km of a main road.

**

1. Very narrow quarry width and/or low-lying area with poor drainage.
2. Narrow quarry width exposed along very steep to cliff-like hillside, or adjacent a major waterway.
3. Narrow quarry width exposed along gently sloping to moderately steep hillside.
4. Reasonable quarry widths exposed along a gently sloping to moderately steep hillside.
5. Reasonable quarry width occurring near the crest of a hill. Excellent drainage.

***

1. None to only a few samples analyzed.
2. Several samples analyzed. No drill hole data available.
3. Several samples analyzed with limited drill hole data available.
4. Numerous samples analyzed and data available from several drill holes.
5. Numerous samples analyzed and data available from many drill holes. Quarry development in some cases.

DEVELOPMENT PARAMETERS FOR ORDOVICIAN-SILURIAN LIMESTONE DEPOSITS IN NEW BRUNSWICK

DEPOSIT NAME: Windsor

N.T.S.: 21 J/6

DEVELOPMENT PARAMETERS		RATING				
		1	2	3	4	5
1.	Formation			X		
2.	Grade range			X		
3.	Grade continuity			X		
4.	Estimated reserves			X		
5.	Observed max./min. thickness					X
6.	Estimated overburden					X
7.	Dip ranges	X				
8.	Deposit access					X
9A.	Ecologic location with respect to dwellings	X				
9B.	Ecologic location with respect to waterways	X				
10.	Topographic setting			X		
11.	Level of exploration/ development				X	

DEPOSIT PRIORITY RATING (60 max.): 34

For a more detailed explanation concerning priority ratings see Development Parameters Scheme on adjacent page.

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